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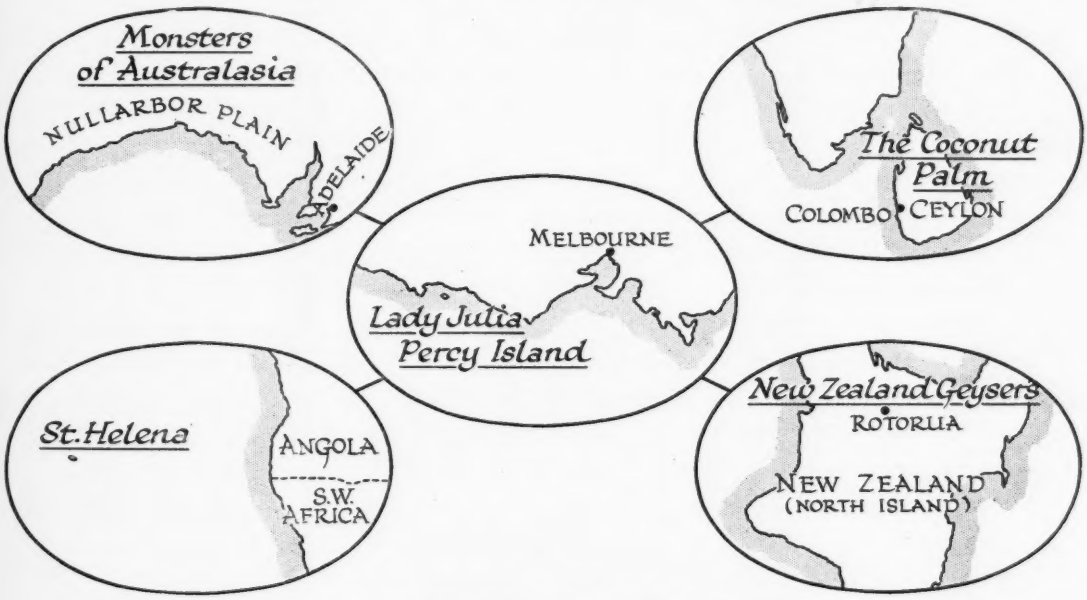

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(*Continued on page* xliii)

DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XVIII. No. 209. MAY, 1937. PRICE 1s. NET

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Editor: L. Russell Muirhead, M.A.
Publishers: Benn Brothers, Ltd. All communications respecting editorial matters to be addressed to the Editor; all questions of advertisements and subscriptions to the Manager.

Offices: Bouverie House, Fleet Street, London, E.C.4. (Closed on Saturday.)
Telephone Central 3212. Telegrams: Benbrolish, Fleet, London.
Annual Subscriptions 12s. 6d. post free anywhere in the world. Single numbers 1s. net; single back numbers more than two years old, 1s. 6d. net; postage (inland and foreign) 2d.
Binding cases, 2s. 6d. net each; postage 6d.

May 12th, 1937

The Coronation of King George VI and Queen Elizabeth, which Discovery celebrates in this issue, is an event of immense significance, far transcending the personalities chiefly concerned. It is primarily an act of dedication on the part of the Sovereign and his Consort. Seeing, however, that this act is being made in the presence and with the assent of representative men and women from every part of the Empire, it assumes the character of a re-dedication of the British Commonwealth of Nations to the higher purposes for which in their conviction it was called into being. Moreover, the whole world is looking on with sympathetic attention while the British race is affirming afresh its devotion to causes and institutions which have a continuous history of nearly one thousand years.

His Majesty King George VI.

Two years ago Discovery rejoiced to take the opportunity of commemorating the Silver Jubilee of King George V. The background of British sentiment is the same now as it was then, but a fundamental distinction has to be drawn between the two occasions. At the Silver Jubilee the British peoples were looking back over twenty-five years of a then unfinished reign. They recalled joys and sorrows, triumphs and disasters, which their Sovereign had shared with them. Their feelings were chiefly those of gratitude to the man and of pride in his reign. Their thoughts were in the main of an epoch nearing its completion, and of tasks worthily accomplished.

The Coronation of King George VI strikes an entirely new note. There is no delving into past history here. Emphasis is wholly on the future. The King has only been on the Throne since last December, and his title to a high place on the roll of British sovereigns has yet to be earned. With the Coronation he will enter into his full heritage, and Westminster Abbey will echo the prayer that his reign will be as beneficent as that of his father. The Coronation, rightly regarded, is the charter of the

younger generation. The King is being crowned during a period of exceptional unsettlement in the world outside. There is a ferment abroad such as has not been seen since the days of the French Revolution, but now, as then, the British nations stand steady as a rock. They continue to give an example of just government, and intellectual freedom within them maintains an unchallenged position, despite all attacks, insidious or open. The maintenance of these principles is of vital importance to the progress of knowledge not only within the Empire but throughout the world.

Notes of the Month.

On an occasion when the sentiment of loyalty is in the air, and our thoughts and good wishes are irresistibly directed towards the man whose position as ruler of the British Empire is this month being solemnly confirmed, the way of Discovery is clear. We, in England, have perhaps occasionally committed the fault of taking the Empire too much for granted, since affection begets familiarity; so the time is accordingly ripe for awakening interest in those parts and features of the Empire that are little known and unfamiliar. Needless to say, only a few of the many marvels of a wide Empire can be even referred to within the compass of a single issue of this journal, and in this, our "Outposts of Empire" number, we can do no more than suggest the multifarious interests of those lands which are under the protection of the British flag. However, when a part, and an old-established part, of the Empire receives letters addressed as though it were in the United States of America (actually some thousands of miles distant from the said "outpost"), it is time something was done to further the accurate knowledge of the commonwealth of nations that we call the British Empire.

* * * *

Nobody but the most confirmed and discontented grumbler will grudge the amount of money expended on the Coronation celebrations; for, setting all considerations of loyalty and respect aside, we all have a chance of taking a part, small though it may be, in the celebrations. We trust, however, that we shall not be considered curmudgeonly if we draw attention to another item of public expenditure on which a good deal has been said lately. Last month in these notes we made reference to a letter, signed by important and representative men in the world of learning, suggesting a readjustment of the scale of Civil List Pensions. A previous appeal made in the House of Commons evoked no satisfactory response on the ground that no considerable body of public opinion supported such a readjustment. Is it a fact that the requisite body of public opinion has been found to support the proposed increase of ministerial salaries and pensions, and the payment of a salary to the leader of "His Majesty's Opposition?" The question is not whether the gentlemen concerned are worthy of increased emoluments, but whether the opinion of the country has been sounded regarding the expediency of such an increase to-day.

* * * *

Only the privileged have so far seen all the pieces of the new coinage "in the flesh." From photographic reproductions in the Press, however, they appear to leave little to be desired in the way of design, and the departures from the familiar seem in every case to be artistic and practical. We have actually handled the new-style threepenny piece and can vouch for both its convenience and its appropriateness. The inclusion of the wren on the reverse of the farthing, however, is open to criticism on scientific grounds. It is, perhaps, rather futile to point out that the wren is not the smallest British bird; it is undoubtedly the smallest *common* British bird. But the idea of linking the wren with the idea of royalty is another matter. It is doubtful whether the legend of the wren being the king of the birds is a British legend (apart from its Irish associations); and, in any case, the "kingship" of the wren is of rather a sinister kind, typifying as it does the "Divine King," who is periodically sacrificed to ensure favourable harvest weather—a practice still obtaining in the remoter Sudan. Let us, therefore, be content to regard the wren as a friendly little bird, an excellent subject for its place on the nimble farthing.

* * * *

At Wadebridge, Cornwall, last month three London men were fined £11 each for taking 11 raven's eggs off the Cornish cliffs. The position of British wild birds being what it is, the administration of so wholesome a deterrent is, to say the least of it, timely. The egg-stealer must be regarded as in the category of citizens who are endeavouring to make money in a way detrimental to the majority, and must be treated accordingly. It is interesting to note that the men concerned were equipped with egg-boxes, coils of rope, climbing irons, and a fast car. Equipment of so elaborate and expensive a nature would not have been acquired if there had not been a good market for the eggs obtained, and while the egg-stealers can be suitably dealt with by game wardens, country police, and provincial magistrates, it would be as well if a keen search could be made for the "receivers" (presumably urban) into whose hands the stolen eggs eventually pass.

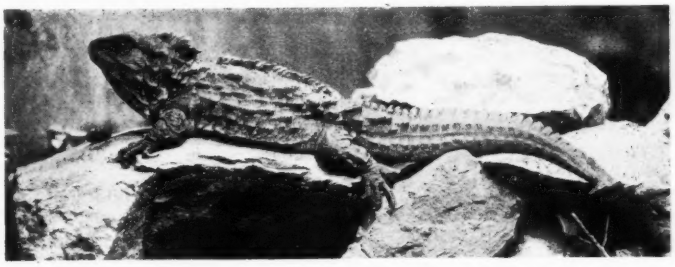
Monsters of Australasia

By Edward Samuel

The peculiarities of the mammals of Australia are well known. Less famous, but no less interesting, are certain unique lizards and insects which inhabit Australia and New Zealand and the neighbouring islands.

ALMOST every individual portion of Australasia has some unique specimen of fauna; Australia has the Platypus, Tasmania its Devil, and New Zealand the Tuatara, or *Sphenodon punctatus*, a direct descendant of the dinosaurs. The tuatara is not a lizard; it represents an order by itself equal in rank with snakes, tortoises, crocodiles and lizards. It has abdominal ribs performing the same protective function as the abdominal plates in tortoises and turtles, while the skull is remarkably bird-like in structure.

Much has been said about the so-called third eye of the tuatara. This is sometimes known as the parietal or pineal eye. It is much like a simple eye, but is completely covered with skin, and is invisible from the outside except on a very young tuatara. This pineal gland is found in many vertebrates, but is most perfect in the tuatara, and is probably the remnant of an original pair of eyes—the left one. The vestigial right eye is poorly developed and exists in the form of an elongated body beneath the left. A peculiarity in the tuatara is the teeth; they are simply sharp projections in the actual jawbone and are not detachable.



The tuatara, a unique survival from the age of the giant lizards.

The question of respiration and changes in the body temperature of the tuatara is interesting; the tuatara has been watched for one hour without any visible sign of respiration being noticed. Under normal summer conditions they are seen to breathe once in every seven seconds. It is unfortunate that the time has gone when the tuatara could be studied on the mainland of New Zealand. It is now found only on groups of islands off the east coast of the North Island from Cook Straits to the North Cape.

Beneath the trees on these islands are many burrows, from which comes a faint musky odour peculiar to the petrels, which make these islands their nesting-places. During the day there is no sign of life, the birds are away scouring the ocean, perhaps a few are quietly sitting on eggs in the depths of the burrows. At the entrance of one of these burrows, or on a bank in the open, a tuatara is found entirely motionless, his grey colour blending perfectly with the surrounding earth. An adult reptile is about two feet long—a third of that is tail. Along the mid-line of the back, from crown to tail, runs a crest of spines which stand erect and appear formidable. They are, however, soft and flexible, and are simply the vestiges of a defensive device in the tuatara's ancestors.

The reptile is unwilling to move unless hard pressed. Normally there is rarely any need to run and he has lost the habit, although not the capacity, of speed. When need arises he can move quickly enough to elude most attempts to capture him. The association of the tuatara with nesting petrels is interesting. Many sorts of petrel breed on these islands. In the summer the birds and the reptiles jointly occupy the burrows. In the winter the tuatara is sole tenant. Sometimes they occupy the same chamber and ignore each other. During the day both sleep, and at night the petrel welcomes her mate and the tuatara sets out on his nocturnal hunt for insects. When there are chicks, often the tuatara does not harm them, although sometimes one is killed. In the winter the birds depart for the northern hemisphere and the tuatara digs in at the end of the burrow to hibernate.

As with snakes and lizards, their prey must be on the move before they pounce. In captivity they soon recognise raw meat as food; they crawl along slowly up to it and then pounce down suddenly, after raising the front part of the body and arching the neck. Mastication is a slow process. About April their desire for food weakens, and early in May they retire to a quiet corner and remain inactive until the spring. They are not completely asleep and if disturbed will move. Reproduction is by means of eggs laid in November. Between ten to fifteen of these eggs are usually

found together in a trench or burrow covered with leaves and earth. It is a moot question whether each tuatara has a separate nest, or whether it is a community affair.

The eggs do not hatch until the middle of the following summer, a period of thirteen months. On hatching, the young tuatara is six inches long, and grows fast at first and much more slowly in succeeding years. Young tuataras are very active, in captivity even over-active. A young specimen once jumped about without resting for three or four days and then died. Tuataras live to a great age, probably through conserving energy. In Dunedin, specimens were under observation for over fifty years, and the Maoris have a record of one living in a shell pit at Motiti Island for over 300 years.

The tuatara is moderately intelligent, and shows inquisitiveness at hearing an unusual sound. Parties landing on the islands which are uninhabited sometimes after making a noise will see a dozen tuatara come out of their burrows while they look around enquiringly for some time. They are attracted and fascinated by music as snakes and eels are affected. The temperament of individuals varies, and few are definitely bad-tempered. In captivity they are intelligent enough to recognise old acquaintances and to be timid with strangers.

A bite from a tuatara is to be avoided, for the powerful jaws can be snapped with great precision like a vice, and once the jaws are closed it is no very easy matter to open them.

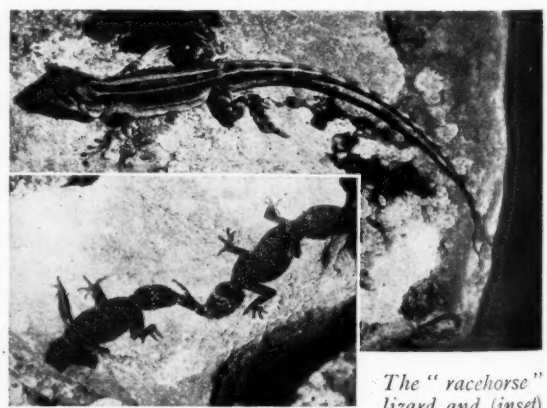
The Mountain Devil

The vast Nullarbor Plain, traversed by the Trans-Australian railway, between South and West Australia, is the home of a number of unique examples of lizard life. Perhaps the most curious is the Mountain Devil (*Moloch horridus*), formidable looking, yet harmless. The Mountain Devil is anything up to a foot in length, and is simply one mass of spikes. Its head and brain in particular are specially protected by a large bump consisting of two horns, and from the resemblance in this respect to His Satanic Majesty the animal derives its name. On the neck there is a very pronounced fleshy excrescence, something like a knapsack. It has been suggested that this is an extra food storage for hibernation; but it has been proved that the knapsack is simply a solid lump of tissue. Probably this excrescence is provided by nature as a false head to deceive the birds which are the enemy of the Moloch. This lizard has a habit of putting its head down, and whilst its head is so bent the knapsack resembles the head; birds would attack it in mistake for the head, without any harm resulting to the Mountain Devil.

This little animal lays from eight to ten eggs in November, and they are about half an inch in diameter, and three-quarters of an inch to an inch in length, with a tough leathery skin. These eggs are soft-shelled, and if exposed to strong light even for a minute or so, their fertility is destroyed. The eggs are laid in a sandy patch, and are at once covered and left to hatch for themselves, like the eggs of a heavily armoured and giant distant relation, the crocodile.

Like the chameleon, the Moloch possesses the power in common with other lizards of this locality of changing its colour in a remarkable way, so as to harmonise more or less with the colours of the objects about it. It also changes colour when its temper is ruffled. An interesting feature about the Mountain Devil is that it does not drink through its mouth, but absorbs the water through its body, just as a piece of blotting paper would soak it up. If the Mountain Devil is placed in a tray of water on a hot day, very soon moisture will be visible on the upper portions of the skin, it having been soaked up through the animal's surface in contact with the water. It is assumed from this that it ordinarily obtains its moisture from dew, and perhaps from the damp sand in which it burrows.

The Sleepy Lizard (*Trachysaurus rugosus*), also known as the Stumpy-Tail Lizard, is notorious for the sluggishness of its movements, and moves along at almost a snail's pace. It is a hideous but quite inoffensive reptile, dark brown in colour, with yellow spots, whilst its belly is greyish, with brown spots, and its palate is black. Its body is round and thicker than a man's wrist and the length of it is anything up to eighteen inches. It sleeps generally all day, and is very difficult to rouse into any state of "activity," even a good hard kick from a man failing to produce an effect. When once roused, however, it can show fight, opening its jaws very

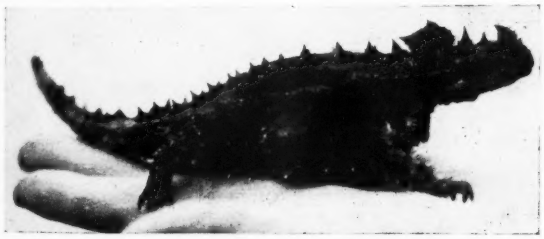


The "racehorse" lizard and (inset) the "sleepy" lizard, also called the "stumpy tail" lizard.

wide, and if it should bite a person the effect will be very severe. The sleepy lizard is insectivorous.

The Racehorse or Cycling Lizard is also called by the blacks "Duc-all." Scientifically it belongs to the *Agamidæ* family, and its specific name is *Amphibolurus candidicinctus*. It is a fair-sized lizard, growing to about fifteen inches in length. The front legs are small, but the back ones are very large, and the tail is long and has circular stripes around it. It runs at an incredible speed, hence it receives the name of the "Racehorse," and the movement of the back legs bears a remarkable resemblance to the motion of a cyclist, from which fact many people call it the "Cycling" lizard.

When the lizard is feeding or moving about, two inches of its tail is used as a support, which leaves quite a distinct mark on the sand; but when excited or in flight the lizard raises its tail high above the body. Chasing the Racehorse Lizard is to the blacks what coursing is to the whites. It is no uncommon sight to see a score of young blacks enjoying the sport of chasing one of the lizards, and if one may judge from the shouts and roars of laughter, the diversion causes great amusement and excitement. The Racehorse is too speedy for the Blacks and too elusive for their sticks and stones. This lizard is of an hibernating nature, seeking the seclusion of a burrow in which to spend the winter



The "mountain devil," Moloch horridus.

months. In the spring it emerges from its winter quarters and about November the female lays her eggs, as many as eight being found in the nest. In size, these eggs resemble those of pigeons, but the ends are more rounded, and the shells much softer, as is usual in the case of the lizard family; and again, as is usual with nearly all other members of reptilia, the eggs are hatched by the heat of the sand in which they are deposited.

It has the ability to change its colour at will. Place a Racehorse Lizard on a pink handkerchief and it will quickly assume that colour. Sometimes when caught they are red around the head; place them in a dark box and they will turn black, and the white rings around the tail, which are a feature of their natural colouring, will also turn dark grey.

The Frog Lizard is also known as the Barking Lizard, from the fact that when teased it opens its mouth and barks. The Blacks call it "Coor-a-nib." It belongs to the Gecko family, and the head portion of this lizard bears a remarkable resemblance to a frog. Perhaps it is the connecting link between the families of the frogs and the lizards in the great scheme of evolution. Its length is about five inches, and in colour it is usually a combination of yellow spots and black markings, with white on the underpart. The older lizards develop small spines, but they are very minute, and, unlike the Mountain Devil, the spikes play no

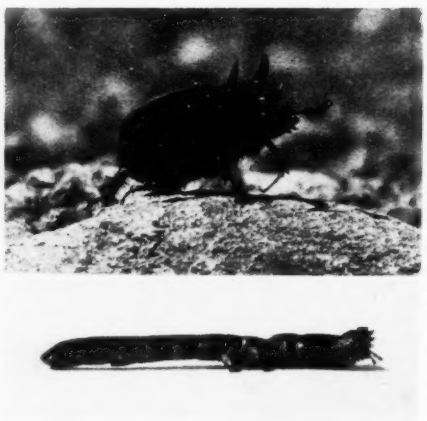
Two rock lizards. This species is very common on the Australian plains.

part in nature's scheme of defence, as in the younger lizards they are entirely absent. Like the Mountain Devil, it is insectivorous and is a splendid fly-catcher. The tail is easily broken off, but when that occurs no harm is done for another one soon grows. The Frog Lizard has a peculiar fat tail, which is used as a prop. It is no uncommon thing for these lizards to be found with two tails—the old one damaged and the new one growing. When the new tail reaches maturity the old one falls off. A very interesting feature about the Frog Lizard is that when attacked it has the power of casting its tail; and the cast-off tail jumps about, thus diverting attention to it and enabling the lizard to escape.

The Rock Lizard can be met in great numbers all over the plains, and wherever there is a bare patch they can be seen scuttling at a great speed. They consume an enormous number of flies and insects of all kinds and are quite harmless; in fact they can easily be tamed. They have the same power as the Frog Lizard of doing conjuring tricks with their tails, and seem to shed them at the least pretext.

We have dealt with all the most interesting varieties of lizard life on the Nullarbor Plains, but there is probably an infinite number of species as yet unknown. It is suggested that specimens of lizards quite unknown live far underground in the huge caverns of the Nullarbor, where exploration work still continues.

An extraordinary insect inhabits the sandhills of Central Australia; it is an elusive sand burrower of the genus *Cylindrodes*, known to science as the Mole Cricket and to the blacks as "Mirrin Muckoo," but in Australia colloquially called "The Circular-Saw Grub." As it moves along on the surface, this insect makes a raised seam of sand, which sometimes extends to about two chains; and it is impossible to ascertain from the trail in which direction the Circular-Saw Grub has gone, for the raised seam gives no clue. The method adopted to find it is simply to dig at one end of the track, and if the grub is not there try the other end, where the insect is generally found enjoying a rest. The actions of this insect are intensely interesting. Whilst on the surface, it can either advance or move backwards by means of its centre legs (which in motion resemble the caterpillar wheels on a tank). A remarkable feature of the insect is the possession of two small circular saws with sharp teeth. These saws are situated one on each side of the head, and are perhaps more oval than circular in shape. They are about a quarter of an inch long, three-sixteenths of an inch wide, and one-thirty-second of an inch thick; they work up and down at any angle required, sawing a tunnel for the insect to get along in, the little caterpillar propelling the heavy rear portion. To assist the action of the saws the head portion of the insect turns, as if upon a swivel, in any desired direction, thereby allowing the cutters great freedom of movement.



The "pig" beetle (above) and the "circular-saw grub," described on this page.

The tracks of the Circular-Saw Grub are usually found running from the top to the bottom of a railway cutting in the sand; it took much investigation in the first instance to ascertain the origin of the curious little sand ridges and discover this grub. The blacks are really responsible for showing it to the white man, and also for explaining the methods and habits of this unique insect.

There are many strange beetles which infest the country around Central Australia; one of the most curious is one which bears such a remarkable resemblance to a pig that it is aptly termed "pig" beetle.

The arrival of the beetle is announced by a very pronounced buzz, and a thud as it strikes the wall, and another as it falls to the floor. The Pig Beetle has two large horns or spikes over the rear portion of its head, and two smaller ones immediately over the narrow front of the head. It has a small rounded snout about one-sixteenth of an inch in diameter, on each side of which two long antennæ protrude; and above these there are two black eyes which are very large in comparison with the size of the beetle.

New Zealand, in common with Australia, owns several varieties of native fauna which are of very great interest, but which are rapidly becoming extinct. One of these is a most interesting snail, known to science as *Placostylus hongii*, and to the Maori people as pupwharakeke (literally flax snail). It has a striking shell, up to three inches in height by an inch in width, solid in structure and coloured rich chestnut-brown with the aperture reddish.

There are three species of *Placostylus* known from New Zealand, and all three varieties are found solely in the North Auckland Peninsula. One of these was found only on the Big King, the large island of the Three Kings group; unfortunately this species is extinct.

Another variety is found only at the extreme northern end of the North Auckland Peninsula; the third member of the family was found to occur in the district between Whangarei Heads and Whangaroa.

When the author resided in this locality thirty years ago, scientists from all over the world were continually writing for specimens, and North Auckland became quite famous on account of harbouring such a curosity. These snails are vegetarians and they live on dead karaka and pohutukawa leaves. They are entirely coastal in distribution and seem always to prefer the cliffs and pohutukawa slopes.

Trace the present distribution of all the snails related to the *Placostylus*, and you will find that outside New Zealand waters the only ones known to be in existence are in the Melanesian Islands, northwards to the Solomons and eastwards as far as Fiji.

It is notable that this large area of distribution of these snails coincides exactly with the now submerged "Melanesian Plateau," a system of connecting land which at a moderate depth unites with the North Auckland Peninsula, all the Melanesian Islands in which these snails occur. Deep water in the Tasman Sea separates this former continent from present Australia, where no snails of this type occur. It is this ancient geological history in the background which makes the study of the mere snail such a matter of absorbing

interest, and it would be a great pity if these living pieces of evidence of the past history of New Zealand's existence as a continent were allowed to become extinct.

Unfortunately the *Placostylus bollonsi*, the largest specimen of all from the Three Kings, has already become extinct. This fine snail, which is over four inches in length, was discovered by the late Captain J. Bollons, for many years in charge of the Government steamer *Hinemoa*, in 1901. As far as can be established only fifty specimens were taken, and there are no more. There can be little doubt that at one time they were plentiful, but when the most northerly tribe of Maoris in New Zealand, the Aupouri, fled from the northern mainland they settled at the Big King, and evidently cleared much of the island for cultivation. The effect of this was to diminish the snails to a very small colony, which never recovered after the Maoris left. Subsequently goats were introduced, and when the author visited the Big King in 1911 there were herds of hundreds of them. The goats cleaned up the undergrowth, rendering conditions unsuitable for these snails.

The second type, *Placostylus ambagiosus*, once occurred in teeming millions all round the coastline of the extreme portion of the North Auckland Pensinsula, but they also have been so reduced that extinction is threatened unless something is done to preserve as sanctuaries the small areas occupied by the two surviving colonies. One of these is on the small island off Cape Maria Van Diemen, where the lighthouse stands, and the other is in a small area of natural forest between Spirits Bay and Tom Bowling's Bay, about twenty miles south of Cape Maria Van Diemen, near the North Cape on the east coast of New Zealand.

Nests of *Placostylus* were found here by Mr. A. W. B. Powell. They were cylindrical depressions in the soil of about one inch in depth, and the same in width. The eggs, which hatched by heat generated by the decaying leaf mould, numbered from fifteen to eighteen per nest, and were thin-shelled, oval, and about a quarter of an inch in length. A very disconcerting feature is the fact that most of the eggs are eaten out by ants, and only about two or three out of every batch reach maturity, the reason probably being that there are few insectivorous birds in this district.

The British Association and the Empire

It is now nearly eight years since the British Association held a meeting outside Great Britain, the last overseas gathering having had its location in South Africa in 1929. This meeting was the seventh to be held in the overseas dominions since the first Canadian meeting at Montreal in 1884. Canada has now been officially visited four times, South Africa twice, and Australia once. The Canadian meetings were confined each to one city—Montreal, Toronto (twice), and Winnipeg—while the South African and Australian meetings were spread over several centres.

No immediate plans for another overseas meeting are in hand, but the formal invitation of the Indian Science Congress Association for the British Association to send a party to hold a joint session in India in January, 1938, at the celebration of the Silver Jubilee of the Indian society, has been accepted by the Council of the British Association.

The history of the imperial activities of the Association was detailed by Dr. O. J. R. Howarth, the Secretary, in a paper read before the Royal Society of Arts, and published in the *Journal* of that society on June 13th, 1930, and his words of seven years ago hold good to-day. We are perhaps even more surprised, now than then, to hear of the storm of protest aroused by the first proposal to hold a meeting in Canada. Members of 1881 were heard to allege that there was no science in Canada and that a Canadian meeting would be little more than a glorified picnic. Needless to say, the success of the Montreal meeting quashed such objections. The Australian meeting of 1914 was rudely interrupted by the outbreak of war, but even so was carried on to a successful conclusion; and the outlook for future meetings in the overseas Empire remains fair.

So much for the visits of home members of the Association to the meetings in the overseas Empire; but what, it may be asked, has the Association done for imperial scientists dwelling overseas? The vast majority of the meetings are still held in the British Isles, and the expense involved to any individual man of science from the Dominions or Colonies must needs be heavy. There is nothing in the Charter of the Association to prevent two meetings being held in a year, one at home and one abroad; in fact the wording of the Charter, with its insistence on the phrase "promoting intercourse" distinctly encourages an increase in the number and a further extension of the locations of the meetings. Resources to realise this extension are not yet in the hands of the Association; but its responsible officials are aware of their obligations to British science in the widest sense. Perhaps the realisation of a scheme of frequent scientific intercourse within the Empire may pass before long from the region of dreams to the more substantial territory of hopes.

Lady Julia Percy Island

By Professor Frederic Wood-Jones

This article, by a member of the recent McCoy Expedition, describes the life led by bird and beast on an island only occasionally visited by man.

In early 1936 the McCoy Society for Field Investigation and Research undertook the first complete ecological survey of Lady Julia Percy Island. Lady Julia Percy Island lies off the coast of Western Victoria (38°24′ S., 142° E.), separated from the mainland by a channel some five miles wide, and with as much as twenty fathoms of water intervening between it and the coast of Victoria to the westward of Port Fairy. Various unsuccessful attempts have been made to exploit it for grazing, for pig raising, or as a source of guano, but to-day it remains uninhabited. Over 100 feet high, sheer on all sides, save for a precarious landing to the north, it is exposed to all winds on its elevated plateau which is a mile and a quarter long and three-quarters of a mile wide. A century ago it was covered with a dense, almost impenetrable, growth of the mixed bushy scrub that characterises certain parts of the coast of the adjacent mainland. Some sixty years ago this dense scrub was still standing over the major portion of the island; but to-day the whole of the plateau is devoid of any growth more majestic than bracken fern and thistles. This denudation of forest cover is due to human interference, for pigs were at one time turned down on the island, rabbits were liberated and are still living in their thousands, and sealers, fishermen and guano workers have cut down and burned the stunted and wind-blown trees that formerly covered the island.

The whole of the flora and fauna of the island tell the same story as that which was unravelled by the geologists of the party. No land molluscs live on the island, though even the most inconsiderable of the islands of the Bight, and of Bass Straits, support a flourishing land shell fauna. No slugs were present, no amphibia. The only earth worm was not an Australian species, but was one introduced from Europe—an eloquent testimony to the reality of human interference in the dispersal of animal forms. There were no snakes, and the only reptile was a lizard which has an aptitude for being dispersed on every tiny fragment of land that lies off the Australian coast. No mammals live on the island plateau save the swarm of introduced rabbits, and the history of their advent is well attested. The only other mammals are the sea lions that resort to the island to breed, to raise their pups, to play, squabble and indulge in aquatic sports, and generally to have a wonderful time of fooling about that renders them the most engaging of animals for the casual observer—and the most lovable to the real student of nature.

It is a noteworthy fact that the sea lion of Lady Julia Percy Island differs profoundly, both in behaviour and in anatomical characters, from the species that inhabits the islands of the great Australian Bight. This sea lion is a resident and local species, just as is the sea lion of the islands to the westward, and it is much to be desired that local and uninformed legislation will never be directed towards the slaughter of these animals, whose distribution is so restricted and whose economy is, at present, so little understood.

The birds inhabiting the island are of two kinds, the land birds resident and breeding in the island, and the truly marine species that breed upon the plateau or among the rock boulders. In addition to these breeding species there are the visitors, both land and marine.

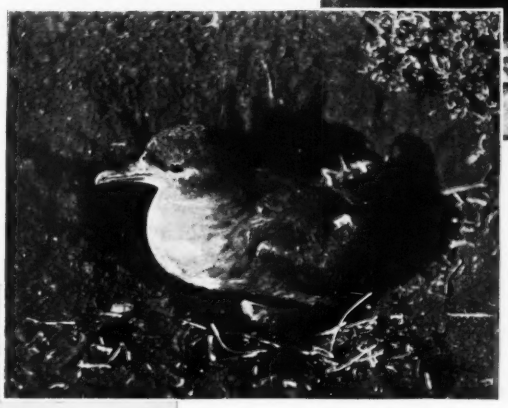
The resident and breeding species of land birds are of no special interest. Native swallows, pipits, chats, and red-capped dotterel breed in their accustomed sites upon the island, and only the pipits and the chats are numerous. The fine native swamp harrier is the domin-

Sea lions playing in the surf that breaks upon the beach of Lady Julia Percy Island.

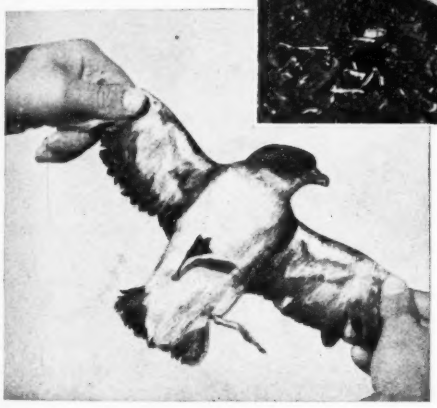
ant bird, and it breeds among the bracken ferns upon the open island plateau. On our arrival, these birds were so tame that it was possible to pick up the fully fledged young birds from their nests among the bracken, but, although they were not molested, they very soon learned all the wariness of their kind. They are the most conspicuous birds of the island and, at almost any time of the day, half a dozen or so could be seen floating above the plateau on the watch for young rabbits, penguins and mutton birds. Even the kestrels and the peregrines, which had apparently nested on the rock ledges of the cliffs, took a very minor part in policing the plateau.

Introduced starlings and sparrows have reached the island but they are inconspicuous and timid, and, for the most part, have their home in the volcanic cliffs and find their food upon the seal beaches.

Penguin chicks waiting for their mother to make the long climb to the breeding burrow.



A mutton bird still sitting on its egg after its burrow has been dug open.



The island's permanent resident sea bird, the diving petrel.

Of the true sea birds the Bass Straits Mutton Birds or Short-tailed (or Slender-billed) Shearwaters (*Puffinus tenuirostris*) breed in large numbers in burrows tunnelled into the soft volcanic earth of the island plateau. The Whale Bird, Ice Bird or Prion (*Prion turtur*) visits the island to lay its egg in the cavities beneath the vast basaltic boulders that strew the shore line, and the talus slopes of those parts of the island where the cliffs do not rise sheer from the water's edge. The shearwater and probably the prion are seasonal breeding visitors, but almost certainly the little Diving Petrel (*Pelecanoides urinatrix*) is a resident bird, breeding on the island and returning to it at dusk all the year round. The diving petrel is one of the most attractive of sea birds, a sturdy, manly, independent little fellow, with the most beautiful turquoise blue legs and feet and shining black and white plumage. He comes to the island only when the evening dusk has settled down, and as he comes he makes a little noise like a new-born puppy seeking its mother. From beneath some great boulder there comes the same little sound in answer, and soon, after flitting round like a bat in the dusk, he creeps into some chink, and a duet of little puppy-like love notes comes forth. The diving petrel is a very lovable little bird.

The prion is a ghost. A fluttering thing of pale grey-blue and white, a delicate wraith of a bird that comes moth-like into the beam of an electric torch and falls confused among the boulders—as it does at every light-house on the islands around the coasts of Victoria and Tasmania. The Bass Straits shearwaters are birds of mystery. Anyone who has watched their evening arrival at a breeding island, seen their wheeling, watched them, as myriads of boomerangs, hurtling in the air, and followed their flutterings as they quarter the ground seeking their breeding burrows, has witnessed one of the most remarkable perfections of avian flight. And then everywhere on the island are the penguins (*Eudyptula minor*). These little blue and white birds are among the most engaging of all the penguins, despite the fact that all their island activities are nocturnal. In solemn thousands they come ashore from the surf, and always

at the same place, and in a sudden rush, every evening.

Every evening the whole company marches and hops up the same well-marked pathway to the island plateau and, at the plateau, disperses along numerous tracks to the breeding burrows. Every step of the way, every jump, every turn, is performed by every individual in the whole great army in exactly the same manner, and with the utmost solemnity. And every bird that, after the whole long journey, arrives at its home finds two beautiful fluffy chicks awaiting it at the mouth of the burrow and regarding it with solemn expectancy. The little blue penguin is attractive beyond all birds in its serious and ordered ways of life, and in its queer sturdy independence that is combined with a most remarkable communal spirit. It is a strange thing that all these birds coming to the island at nightfall, should foregather in the surf until their numbers are complete, and then, making a concerted rush through the breakers to the landing rock, start their long climb together. For this coming and going is their time of peril, and a visit to any island upon which penguins breed tells its own tale. Penguin carcases, killed by harriers, peregrines, and seals, strew the pathway from the surf to the breeding places; and around the rock holes or the burrows in which they breed, are downy chicks ripped open by hawks or gulls. Here they did not have to run the gauntlet of gulls, for, strangely enough, these birds were not present on the island ; but despite this, their mortality was very high.

The Coconut Palm

The coconut palm has long provided the primitive villagers of Ceylon with almost everything they need, and now it is beginning to find a place for its many products in the world's markets.

THE early history of the coconut as a cultivated crop is shrouded in mystery. There are those who believe that it originated in some sheltered valley in South America, and support their statement by pointing out that nearly all the species of palms allied to the coconut are to be found in that sub-continent. The more general opinion is that the place of origin was somewhere in the Malay Archipelago or in the Pacific Islands, states Mr. W. V. D. Pieris, geneticist to the Coconut Research Scheme, in a "Guide to Coconuts," just published in Ceylon.

Whatever the truth may be regarding the place where the coconut palm first appeared, it is a fact that the modern development of the coconut industry has taken place in the East—in the Malay States, the Philippine Islands, the South Sea Islands, India and Ceylon. The uses of the palm are manifold, but how manifold they are is not yet known, even to people who inhabit countries like Ceylon, where coconuts have been in existence since before the reign of Kusta Raja, and grown as a cultivated crop since the times of the Portuguese.

The roots of the coconut palm are of no commercial importance, but they have a number of simple, primitive uses. In the coconut districts of South India, the villagers use an infusion of tender coconut roots in the place of tea. It is said to have a pleasant flavour, resembling coffee. Also, it is quite a familiar sight in Malabar and in certain parts of Ceylon to see pieces of the matted or felted roots of dead palms used as fuel by the poor. These burn well and cost nothing and are greatly appreciated by villagers who find it difficult to obtain firewood. Coconut roots are also employed in ayurvedic medicine in Ceylon and India, and in the native systems of medicine of other eastern countries where coconuts are grown. Their efficacy is said to be due to an astringent substance which is found in the tissues. In the Malay States, they are used in decoctions for intestinal complaints and coughs, and as poultices for rheumatic and other diseases. In Ceylon, the tender coconut roots are roasted and ground and used as a tooth-powder, in conjunction with certain other substances like powdered areca nut. They are also used in decoctions, as an antiseptic lotion for wounds and as a mouth wash and gargle.

To the people of Ceylon, the trunk of the coconut palm is very nearly indispensable. It supplies them with fuel, timber for building—the rafters of most houses being made of nothing but coconut wood—and, quite often, timber for furniture. It is well known in the timber trade as porcupine wood by reason of its peculiar and attractive grain. The seasoned timber from old palms lends itself to ornamental carving ; and in the days when elaborate furniture was in fashion, people took pride in articles made of carved porcupine wood. It cannot be said, however, that coconut wood holds an important place in the timber trade. This is mainly due to the fact that the palm is more valuable for its fruit than for its wood and, consequently, only trees well over sixty years old, that have ceased to bear, are cut down. The supply is, therefore, very limited and, as a result, the seasoned timber is too dear for general use.

The leaves of the coconut palm have many uses.

The stalks or butts are used for burning; the dried leaves provide torches for wayfarers at night; the midribs of the leaflets are tied up in bundles and used as besoms in the house or as stiff garden brooms to sweep up fallen leaves; the midribs of the leaflets are also curiously bound together to make most efficient fish and lobster traps. The most important use to which coconut leaves are put is in the making of thatching for houses. For this purpose, the leaf is split in two along the midrib and the leaflets are closely and very neatly woven together to form the "cadjans" that are placed together in pairs on the rafters, each pair overlapping the other and forming a perfectly weather-proof covering, cool in the heat of the day and cosy at night.

The inflorescence of the coconut, during its early development, is completely enclosed in a tough sheath known as the spathe, which, on bursting, sets it free. While the nuts are ripening, the spathe dries and turns brown and, later, falls to the ground. These dry spathes are of great importance to village life. They provide a very handy form of fuel and a convenient means of carrying fire from place to place, since there are few things better than a dried coconut spathe for keeping alive a burning coal. It is a common thing in the villages to see a woman go to the house of an obliging neighbour, who is able to afford the luxury of safety matches, and beg of him a live coal. The coal of fire is wrapped up in a shredded coconut spathe and may be carried for miles; so that it is no exaggeration to say that a single match can light up a whole village.

The Commercial Fibre

The immature fruit at a certain stage provides the cleanest and one of the most wholesome drinks known to man. At this stage the kernel is soft and sweet and provides, when eaten by itself or with coconut treacle, a most delicious dessert. It is for the sake of the ripe nut, however, and the products of the ripe nut that coconuts are grown to-day. From the husk of the coconut is extracted the coconut fibre of commerce. The extraction is generally done nowadays by machinery, although quite an appreciable quantity of fibre is extracted by hand and used for special purposes. Fibre mills may be seen in most parts of Ceylon where coconuts are grown, but hand extraction is carried out on a large scale only along the coast line of the southern part of the Western Province and in the Southern Province.

Fibre extracted by machinery is marketed as mattress fibre, coarse and fine, bristle fibre, combings, and coireen. Coarse mattress fibre is the grade generally made in local mills, the fine grade, which is much cleaner, requiring special machinery in its manufacture. Bristle fibre, combings and coireen are, as a rule, marketed in two forms, namely, dyed and undyed. Dying may also be done in different colours, but the usual pigments are black and shades of brown.

The Beggar's Hat

The shell has its own peculiar and important uses. The Ceylon beggar holds out a coconut shell instead of a hat. It is the accepted tankard of the village tavern, it is the poor man's drinking vessel, and the bowl in which the village housewife mixes her salt and water for curries. It is an indispensable part of the toddy-tapper's outfit, for it is in a coconut shell that he carries his cinnamon leaf paste and his lime for the purpose of stimulating the reluctant flowers to give up their sweet nectar. It is with a coconut shell that the village mother bathes her infant, and it may be that a coconut shell serves for the platter from which the child eats his first cooked meal. The rubber planter uses coconut shells for collecting the raw latex from his trees. From the shell are made strange lamp-holders, cups and saucers, spoons and ladles, ash-trays, trinket-dishes, chocolate-stands, buttons and a strange medley of other things.

Coconut shells are of the greatest importance on plantations, since without them it would be difficult and expensive to manufacture copra. Long lines of burning coconut shells in kiln-pits provide the heat required for making copra. Lastly, it has been discovered, strangely enough, that the charcoal made from coconut shells has a high gas-absorbent property and it is, therefore, being widely used in the manufacture of gas-masks. Its sudden importance in the trade to-day is mainly due to this cause, and clusters of smouldering charcoal pits, with their clouds of blinding, irritating smoke, are a common sight in the countryside to-day.

Finally, there is the kernel and the water contained inside the kernel. On the average plantation the mature nuts are converted into copra. This involves removal of the husk, splitting the nut, an initial short drying in the sun and a final prolonged drying in a kiln. It is only in the very dry districts of Ceylon, in the neighbourhood of Puttalam, and in certain parts of South India that it is possible to dispense with kiln-drying and to dry the copra entirely in the sun.. From the copra is produced coconut oil and a number of grades of poonac or oil-cake, the difference in the grades depending on the method of extraction of the oil and on the portion of the kernels which goes to form the cake. In the primitive way, the oil is not produced from the dried half-kernels but from dried and grated coconut.

The March of Knowledge.

Pollen in Cold Store

The New York State agricultural research station has found that the pollen of apple, pear, plum and other trees can be safely kept in cold store for two years or more. It should be possible for agricultural scientists in Australia or New Zealand to send consignments to this country confident that it will arrive in fit condition for " crossing " with English varieties.

Heart Beats " Canned "

A new form of electro-medical apparatus called the phonostethograph, developed in one of the laboratories of the Medical School at King's College Hospital, is described by Dr. C. Vaughan Henriques in the *Lancet*. It enables heart beats to be loudly heard or recorded and reproduced ; it is the result of experiments with a new electrical technique and records phonographically the heart sounds. The apparatus has now been standardised, and the form of phonographic disc employed enables the records to be replayed hundreds of times. The doctor can listen with earphones, adjusting the amplifier controls until he gets the volume of sound which he desires and then, bringing the loudspeaker into operation, he obtains a faithful reproduction of the heart sounds.

4,000 B.C.

The excavation at Tepe Gawra, in North Eastern Iraq, carried out by a party from the University of Pennsylvania under Dr. E. A. Speisen, showed a mound that had already been abandoned by 1500 B.C., and 20 occupational levels below it. At the eleventh level a circular citadel in excellent condition was found which combined the purposes of fortress and temple. Two levels lower an elaborate acropolis which must be at least 6,000 years old was disclosed. The buildings themselves and the objects found in them show a high degree of civilisation which had not been believed to exist in so early a period. This was revealed at the annual dinner of the American Institute for Persian Art and Archæology on March 30th, in New York.

Metaphosphate Fertiliser

Calcium metaphosphate made by treating phosphate rock with the hot reaction products of burning phosphorus is suggested as a satisfactory compound for introducing phosphoric acid into fertiliser, as it contains 65 per cent. of the acid. Formerly calcium acid orthophosphate made by treating phosphate rock with sulphuric acid was universally used for this purpose. This product, however, normally contains the equivalent of only 15 to 17 per cent. of available phosphoric acid.

Preventing Rust

An interesting experiment in preserving a perishable mineral in gas is being made at the Natural History Museum, South Kensington. The large piece of meteoric iron found at Cranbourne, Mornington County, Victoria, some 30 miles south-east of Melbourne, about 1850, and presented to the museum by James Bruce in 1862, has been placed in an air-tight glass case containing dry nitrogen, which is admitted from a cylinder concealed below.

Butterfly Enclosure

A butterfly enclosure has been added to the Scottish National Zoological Park in Edinburgh. It is 24 ft. long and 7 ft. wide and high. The front is made of glass panels through which it is easy to watch the inhabitants, and the ends and roof are of fine gauze so that air is admitted freely, but the insects cannot escape. A beginning has been made with the stocking of the enclosure with some bright-coloured moths and swallow-tail butterflies, and other new species will be coming in at frequent intervals.

Saxon Burials

A Saxon burial ground has been discovered close to a railway crossing west of Scarborough. It has also been ascertained that King Athelstan built a hospital close to the same spot in the 10th century. Skeletons of a very tall man with an exceedingly thick skull, and of a young woman with a necklet of resin beads have been found near, as well as pottery, spearheads and urns.

Rare Pots

In 1934 there began to appear in the Near Eastern markets a hitherto unknown prehistoric painted and polished ware of unknown age and cultural affinities. A French expedition traced it to a ruined mound named Tepe Siyalk, four miles west of Kashan in Central Persia, and checked further unauthorised native damage to the site. Two pots of this ware hitherto unrepresented in the British Museum have been secured for the collection, also two " base-ring " cups, probably from Nihawand, but showing some connection with Tepe Siyalk.

New Studio

A studio, new to this country, known as the " live end—dead end " type, has been evolved as the result of research by the B.B.C. The half of such a studio which accommodates the orchestra is free of acoustical treatment on floor, walls and ceiling, all the absorption necessary being concentrated in the other half in which the microphone is normally placed. Acoustical treatment using no less than six inches of " mineral wool " has been specified in some cases.

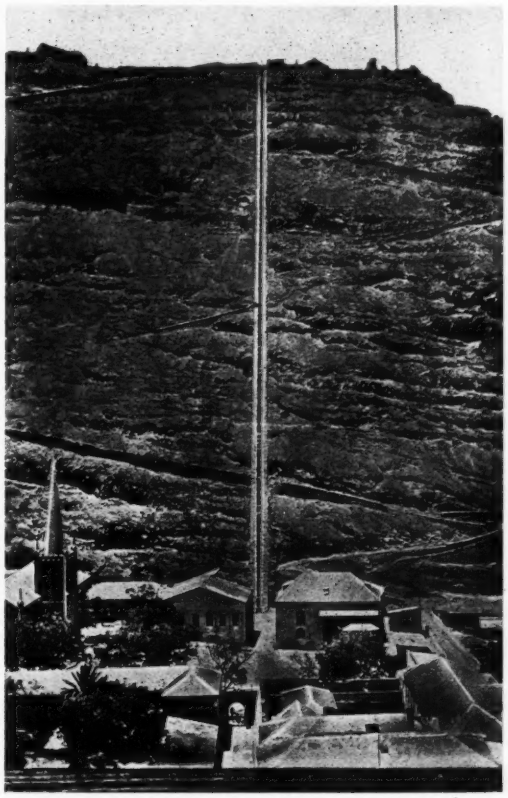
The Island of St. Helena

By L. L. Burton,
Late Senior Medical Officer at St. Helena.

Though St. Helena's position on the main sea-route from Europe to South Africa has brought many travellers into touch with it, the general knowledge of this isolated speck of British territory is unduly scanty. How the island came to be a British colony is the theme of Dr. Burton's article, along with a vivid account of its turbulent annals in past centuries. We are indebted to Mr. E. J. Warren for supplying the accompanying photographs.

In these enlightened days, when exploration has left little apparently to explore, it would appear almost superfluous to write on so well known an island (so one had imagined) as St. Helena. When, however, letters are received addressed by London firms with "St. Helena, U.S.A.," one feels that perhaps there are some to whom the island is little more than a name.

St. Helena was discovered on May 21st, 1502, by Commodore John da Nova Castella, who was on his way home from India at the time. It is situate in 15°55′ S. latitude and 5°49′ W. longitude; 1,140 miles from the African continent, 1,800 miles from S. America, 690 miles south of Ascension, and about 4,000 miles from England. As the day of the island's discovery was the anniversary of the birthday of Helena, mother of Constantine the Great, the island was called after her.



Jacob's Ladder at St. Helena, a stairway of nearly 700 steps.

In 1513, the Portuguese, partly with a view to colonising the island, partly to get rid of a prisoner, left, as its first human inhabitant, Fernandes Lopes, a nobleman, who had incurred disgrace by desertion and was thus being punished. Before landing, his nose, ears, right hand, and the little finger of his left hand were cut off. He was provided with a few negro slaves, pigs, goats, poultry, partridges, guinea-fowl, pheasants, peacocks, vegetables, roots, and a few orange, lemon, and peach trees. After four years he was pardoned and returned to Portugal, but Portuguese homeward-bound ships continued to call at the island. On June 8th, 1588, Captain Cavendish, who anchored his ship off Chapel Valley (now James Valley), found there a settlement comprising several good buildings, and a Catholic church, but by the beginning of the 17th century the island appears to have been practically deserted, being used only as a "post office" by calling ships. It was customary to place letters under huge marked boulders of stone, so that crews from India could obtain news of home.

The Dutch traders to the East next appropriated the island. They took possession and retained it until the year 1651, when the East India Company captured it. After ten years the Company obtained a charter from King Charles II, and subsequently they erected fortifications, and introduced settlers, and new plants and stock. In 1665 the Dutch successfully attacked and retook St. Helena, but within twelve months the English were again masters of the island. They pulled down the original fort (built in 1659) and erected another, which they called Fort James, in compliment to the Duke of York, afterwards King James II. In 1673 the Dutch again took the island, after an unsuccessful attempt at Lemon Valley, by surprising the slave of a planter, who had been fishing by night at Bennet's Point, and compelling him, after they had landed, to guide them up the intricate paths of Swanley Valley to the mountain near High Peak.

At the battle of High Peak they defeated the English, including 500 men from the island garrison, and then pushed on by way of Ladder Hill (700 feet above James Town) to Fort James. The Fort yielded and Governor Beale and the English inhabitants, with their effects, made their escape on board ships then in harbour to the coast of Brazil. Here they fell in with a British squadron under the command of Captain, afterwards Sir James, Munden.

Munden, learning what had happened, sailed for St. Helena, arriving May 14th, 1673. Unobserved and unexpected by the Dutch, he landed 200 men under Captain Kedgwin at a spot on the east coast called Prosperous Bay (from which point Cape vessels are first sighted), and with them a slave named Oliver, who had fled with Governor Beale. The landing place is still named Kedgwin's Rock. Oliver piloted the little army inland up steep and rugged cliffs, until they reached an apparently insurmountable precipice. One of the party, however, named Tom, taking with him a ball of twine, managed to scale it, and established a rope communication to assist his companions up the cliff. In his honour the place is called "Holdfast Tom." Having ascended the precipice, Kedgwin and his "army" gained the heights of Longwood (afterwards world-famous) and took up a position on the top of Rupert's Hill overlooking Jamestown from the East. Munden, meanwhile, was making his way to the northern side of the island, then attacking from the east of Fort James while Kedgwin co-operated from the north. The Dutch surrendered. The island was then left in charge of Kedgwin. Charles II granted a further Charter dated December 16th, 1673, conferring the rights and powers of sovereignty on the East India Company, as Lords Proprietors of the island.

The island was visited by Halley, the astronomer, in 1676, at the spot now called Halley's Mount; the following extracts from old records indicate, however, that life under John Company was not all roses.

One Sarah Marshall had one-and-thirty lashes on her naked body at the Flagstaffe for scandalising Captain Bendall.

A. Parnum was fined five shillings for working on the Lord's Day, and his wife a shilling for cursing the island.

Sottoe, a slave, being chastised by his master, retaliated by attacking him with his knife. He did not do much harm. The man was brought to trial, and though Sottoe pleaded that a fellow-slave had instigated the attack, and that he had been urged on while under the exciting influence of a pipe of tobacco which he had stolen and smoked, it was ordered that his hand was to be cut off. He was then to be hanged, and when dead his head cut off, and placed on the top of the Market House, as a caution to others. The fellow-slave, who was stated to have urged Sottoe on, was led with a rope round his neck to witness his companion's execution, and, after forty stripes on his naked body, was condemned to have a pair of iron pothooks riveted round his neck until further orders.

For attempting to get away from the island, slaves were punished with seventy-five lashes, and in addition had five drops of sealing-wax dropped on the naked body.

The most common military punishment was riding the wooden horse. "William Malling who, for swearing and incivility, doe ride the wooden horse for two houres with a bag of shot at each heele." "Also Richard Honeywood, who doe ride the wooden horse for halfe an houre with two musketts at each heele for slighting the Government and maliciously revenging himself."

It is not to be wondered at that dissatisfaction and discontent had been gradually increasing among the garrison. On April 21st, 1693, a soldier named Jackson, with three companions, planned a scheme to rob the treasury. While the Governor (Johnson) slept they let several more soldiers into the Fort and then sent messages to all other guards, calling them in also. All who objected to the plan were imprisoned in a dungeon built underground in the Fort, for the purpose of securing "villinous and desperat blacks."

In the morning when Governor Johnson came out in his gown and slippers, to give the keys to the sergeant of the guard, he was seized by Jackson and others. On his resisting, three of the party fired on him, mortally wounding him, but also hitting Jackson in the arm. They threw the Governor into the guard house, but permitted his wife, with the assistance of two negro women, to drag his body upstairs to his bedroom. The Governor died that night.

The murderers endeavoured to secure all

Jamestown, St. Helena, looking north.

roads by which intelligence could reach the country, all soldiers who came from the Garrison to the Fort being thrown into the dungeon, where they had already fifty prisoners. Others were sent to spike the guns overlooking the anchorage, while the ringleaders went into the Governor's closet, and brought away all treasure.

They boarded a ship, the *Francis and Mary*, taking with them the Lieutenant-Governor and several others, who, with the master of the vessel, they retained as hostages until they had obtained from the shore the supplies necessary for escape. The Lieutenant Governor, Captain Richard Keelinge, took control on his release, but the success of the late plot had spread a spirit of insubordination, and the blacks rose with the intention of massacring the whites. Keelinge with summary justice seized the ringleaders, and "one was hanged alive in chains on Ladder Hill, and starved to death. Two others were also hanged but cut down alive, and their quarters and heads put in some public cross way for the public view of all negroes."

Plantation House, the residence of the Governor of St. Helena.

During the 18th century the island's history became less turbulent; industry was encouraged, lime burnt, Munden's Battery erected, sugar-cane planted, and tiles made; and the first safe road was constructed from the Jamestown to Ladder Hill. But discipline remained severe and, under Governor Pike, some soldiers, unjustly punished, made their escape from the island in an open boat, and actually succeeded in performing the journey of 4,500 miles to Nevis in the West Indies. It is interesting to note that when, in 1807, measles was introduced, almost the whole population was attacked; while a second outbreak, in 1843, was marked by a high mortality.

In the second decade of the 19th century St. Helena became famous throughout the world. Napoleon Bonaparte arrived on the island on October 15th, 1815, on board H.M.S. *Northumberland*, under the command of Rear-Admiral Sir George Cockburn. Napoleon was accompanied by Marshal and Countess Bertrand, Count and Countess Montholon, General Gourgaud, Count Las Cases and his son, and eight servants. The ex-Emperor walked to the house at the entrance to the gardens (which is at the corner of James Square) near the foot of Main Street, Jamestown. After one night's stay here he was transferred to the Briars Pavilion (now the quarters of the Eastern Telegraph Company), where he lived for two months. After this short residence at the Pavilion, Napoleon was finally allotted the house at Longwood with which his name is principally associated, and where he lived until his death on May 5th, 1821. The end of his association with the island came on October 15th, 1840, when the French frigate *La Belle Poule*, with the corvette *Favorite*, removed his remains to France.

A curious legend that persists on the island claims that a huge cave in the side of the rock near the lawn of Plantation House (the Governor's residence) was the place where Sir Hudson Lowe confined Napoleon, in order that he might watch him from his door-step.

An outstanding feature of the 19th century was the abolition of slavery by the East India Company in 1832, the owners of the 614 slaves on the island being indemnified to the amount of £28,062 17s. Slavery had brought a plague to St. Helena in the shape of the African termites which had been introduced into the island on one of the slave ships. Their activities have recently threatened Napoleon's house at Longwood with destruction, but timely measures by the French authorities have averted serious disaster.

Turning to the geographical position of the island, it became pre-eminently suitable as a port of call for vessels returning from India *via* the Cape, and the abundance of fresh water which comes from springs scattered over the island, and which was the main reason why its Portuguese discoverers first established a colony here, added immeasurably to its importance.

It requires little imagination to estimate the value of an unlimited source of fresh water in this island separated by hundreds of miles of ocean from the nearest land.

St. Helena has an area of about 45 square miles; it is

(*Continued on page 152.*)

New Zealand Geysers

By John Jacobs

In a recent issue the re-awakening of the Great Iceland Geyser was described by one who took part in the work. Here a group of geysers in the Southern Hemisphere is dealt with from the point of view of the visitor.

THE thermal regions of New Zealand hold many wonders rivalling anything of a similar nature in the world. The whole district is attractive, awe-inspiring and wonderful; the lake scenery is unique, with placid sheets of water adjoining, one deep green and its neighbour azure blue. There are many different kinds of baths available, supplying various mineral waters; boiling mud holes innumerable; waterfalls over which hot water flows side by side with cold; boiling pools, sulphur pools, mud volcanoes of varying hues; earth and sand of every conceivable colour, and very many geysers, the most wonderful in the world.

Visitors from all corners of the world visit this region but very few stop to reason and enquire into the activities and causes of the existence of these geysers which they have come so far to see. Maori legends, retailed by guides, regarding the geyser phenomena, while quaint and interesting, entirely fail to appease the curiosity. Geyser activity is a phase of volcanic action that occurs in many parts of the world. They may be seen in the sub-arctic wastes of Iceland, in the remote uplands of Thibet, and to considerable advantage in the famous Yellowstone Park of North America.

A boiling mud pool in the thermal district of Rotorua.

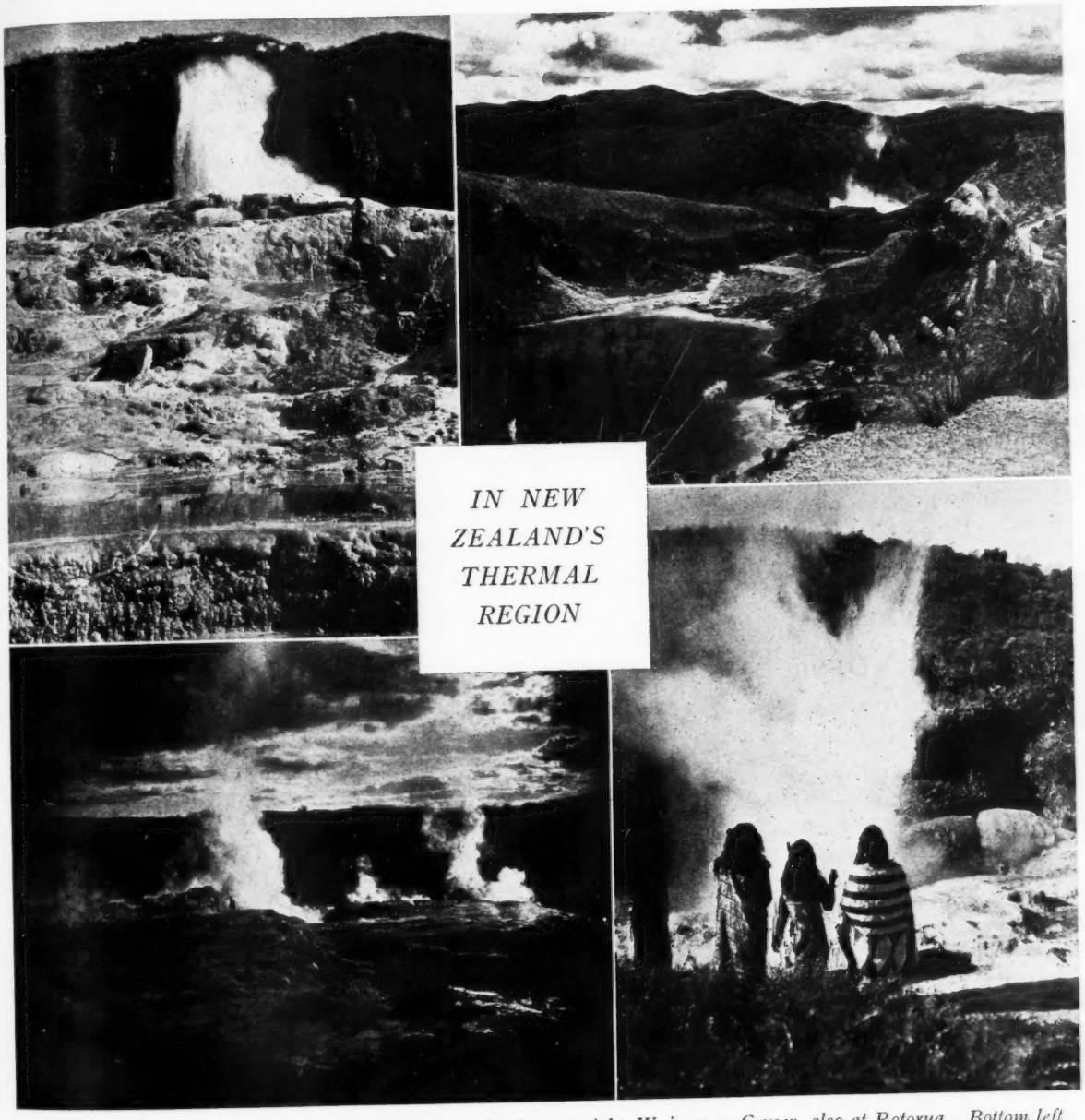
However, from its situation, New Zealand's thermal distrtict offers unique opportunities of studying the whole question in comfort and convenience; the location is handy and accessible, and enjoys a temperate, bracing and sunny climate. New Zealand undoubtedly possesses the world's greatest geyser group, and the renowned district, of which Rotorua and Wairakei are the chief centres, displays geyser activity in endless variety.

Encircling the great expanse of the Pacific Ocean is an almost unbroken chain of active volcanoes. These volcanoes follow a line of weakness along which occur 80 per cent. of the great volcanic eruptions of the world, and which runs through the group of islands comprising the Dutch and British East Indies, lying south-east of the Asiatic continent and north-west of New Zealand.

These islands at present represent the grand focus of volcanic energy upon the globe. No less than 50 active volcanoes occur here. Further south, the line is continued through New Guinea, the Solomon Islands, and the New Hebrides, island groups which lie almost due north of New Zealand. The Australian continent is missed by a narrow margin. The fault next makes its appearance in New Zealand, and is known locally as the Ruapehu—White Island Volcanic Zone. Strung out upon the New Zealand sector are the volcanoes of the National Park, followed by Tuahara, Rainbow Mountain, Tarawera, Edgecumbe (the latter four classed as dormant), and White Island. Altogether no less than 150 active volcanoes exist in the chain of islands which stretch from the Behring Straits down to the Antarctic circle. This great system of volcanic mountains includes nearly half of the habitually active vents of the world. The entire series is a unit, and the physical and chemical conditions of each volcano are the same throughout.

This is of special significance to New Zealand, for it is thus shown that the North Island is part of a closely-related and widely-extended volcanic or geological formation. Rotorua touches the fringe of this great volcanic fault. This does not imply any danger, as every boiling spring or steam vent in the district is a natural safety valve. Volcanoes eject steam in the greatest abundance, and its escape in prodigious quantities from geysers, fumaroles and vents acts as an efficient substitute for the volcanic outbursts.

Ngaruruhoe is a volcano of undiminished power. Violent eruptions have occurred, notably in 1857, 1869 and 1881. In 1870 the top of the mountain was either blown away or fell in. In 1891 the mountain again became



IN NEW ZEALAND'S THERMAL REGION

Top left, Waikite Geyser, Whaka, Rotorua, North Island ; top right, Waimangu Geyser, also at Rotorua. Bottom left. Geyser Flat, Whakarewarewa, North Island ; bottom right, Maoris watching the Papakura Geyser at Whaka, Rotorua.

dangerous, and in 1892 an eruption took place and ashes were thrown as far as the north end of Lake Taupo, destroying, it is said, a tract of forest. During the present century eruptions have been frequent.

Friedlander, a distinguished scientist, in November, 1896, witnessed an almost unknown crater on Tongariro becoming suddenly active. His report is vivid and describes how "a thundering noise, a gigantic pillar of ash-bearing steam shot up, with red-hot boulders, which looked like sparks and fell in parabolic curves. The lower part of the column was aglow with a dark red glare, due to the presence of lava in the crater. There was a continuous display of lightning in the clouds. As the 'sparks' and lightning became rare, flames,

composed of incandescent gas, of about 100 feet in length and of a brilliant blue hue appeared in the storm cloud some distance above the mouth of the crater. The eruption proper was over in a quarter of an hour, but the immense dark cloud continued slowly to rise for several days. The appearance of the crater shortly afterwards gave no indication that a violent eruption had occurred."

In 1908, Te Mari again became active, throwing out quantities of ashes and stones, and discharging great volumes of sulphurous gases. Incrustations of sulphur coloured the rocks in the vicinity a vivid yellow. The tourist travelling between Rotorua and Wairakei on a clear day can distinguish a wisp of smoke rising in the distance from the northern slopes of Tongariro, at an altitude of 5,000 feet. This is the formidable Ketetahi blow-hole. No voice is audible within hundreds of feet of Ketetahi, and the roar of the escaping steam is the most impressive manifestation of its kind in the world. Ketetahi is surrounded by hot springs, geysers and mud pools, and it is one of the most active areas of thermal activity in New Zealand.

Sometimes steam escapes in a continuous jet; an excellent example of this is to be seen at Wairakei, the famous blow-hole of Karapiti. The word Karapiti means screaming, and this steam vent has not experienced a moment's pause for at least 500 years. It emits a weird screaming wail like a lost soul. Maori legend has it that a beautiful deserted wife came thither with her babe and in an excess of frenzy threw herself in. Karapiti was then a steam vent, but silent. Since then the heart-broken mother's voice comes always forth with the steam as she laments over her trouble and lulls her child to rest.

The first spectacle of one of these marvels of nature in action is a sight never forgotten. A murmuring roar and a gradual bubbling up the tube, a few preliminary shots, and finally, the pent-up forces of nature relieve themselves by hurling a huge jet of boiling water and steam hundreds of feet into the air. The jet shows up on the clear, sharp radiant air of the district, and the background is always one of evergreen native trees and shrubs. The landscape is sharply defined and frequently enveloped in gorgeous purpled blue shadows.

Norse Settlements of West Greenland

Recent discoveries at Sandnes on the Ameralik Fjord have thrown light upon the somewhat dark subject of the social organisation of the Greenland Norse settlers.

DURING the last fifty years the Scandinavian countries have been active in exploring the topography and archæology of their early settlements overseas, more especially in Iceland and Greenland; but whereas in the former it has been possible to elucidate cultural development by the aid of the picture of social organisation and of the course of political events to be gathered from the sagas, for Greenland little of this nature is available and the history of these ill-fated Norse colonies has remained obscure. Founded by Eirik the Red in the closing years of the tenth century, after a period of comparative vigour—Garda in East Greenland was the seat of an episcopal see—they vanish in the latter half of the fourteenth century. The archæological researches which have been carried out by the Danish Commission for Scientific Research in Greenland have revealed some details of the tragic story of a community of the characteristic Norse type, half maritime, half agricultural, sinking to a penurious existence which brought degeneration, material, mental, and physical, and finally extinction. Certain peculiarities shown in the human skeletal remains discovered a few years ago have been interpreted as a possible survival of a Neanderthaloid strain; but it is not impossible that they may be a mark of a physical degeneration.

The investigations upon which knowledge of the Norse settlements in Greenland has been based, until recently were confined to the east coast, the District of Julianehaab, the original place of settlement by Eirik; but it was known from the sagas of Eirik and Thorfinn that a settlement had also been sent from there to the western coast. This settlement seems to have been populous for a time—mention is made of a bishop, though possibly only a temporary appointment—but it fell on evil days and would seem to have succumbed finally to the attacks of the "Skrælings" (Eskimo) about 1379.

These western settlements have now been explored. The site of a ruined church on the Ameralik Fjord in the Godthaab District, previously visited once only, by the traveller Brunn in 1904, which has been identified, somewhat tentatively, with the ancient Sandnes, the centre of the settlement, with two important farm settlements on the other side of the fjord, has been

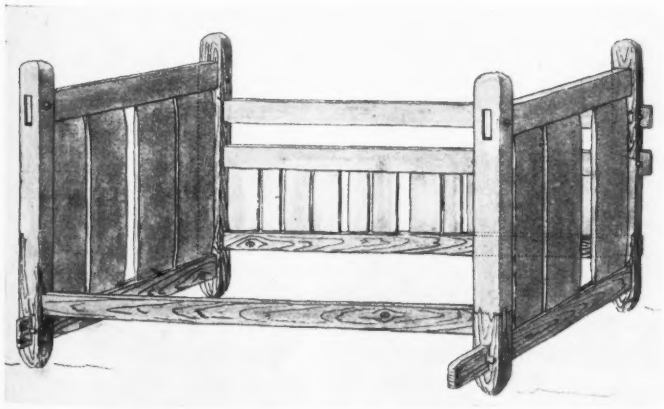
excavated by expeditions of the Greenland Research Commission in 1930, 1932 and 1934, conducted by Dr. Aage Roussell. The results, which have recently been described by Dr. Roussell, throw a flood of new light on the cultural development of the Greenland settlements, as owing to the difference in character of the soil, which on the east coast is unfavourable to the preservation of perishable material, a number of objects new to the Greenland Norse culture have been recovered. This applies especially to objects in wood, bone and baleen, which are especially informative in relation to the artistic and technical equipment of the settlers.

One of the most remarkable objects found at Sandnes was a representation of the Crucifixion, carved in wood and showing the figures of the Virgin and an apostle in a familiar pose. This is a remarkable example of Scandinavian mediæval art and is not of local manufacture. Another example of the Crucifixion carved in wood, but of which the figures had been of metal, in form and technique, similar to examples known from Iceland, excavated in the churchyard, was unquestionably a local product. A model boat in wood, also from Sandnes, and probably a toy, is perfect in detail, and a comparison with early known examples of Norse boats shows that the type had remained unchanged for six centuries. Another remarkable object in wood is a movable bed, from the farm at Umiviarssuk, which is one of the earliest known examples of this type of furniture. The remarkable and unusual state of preservation of objects of wood will be gathered from the fact that in some instances the material still shows its original colouring.

Thirteenth century carving in wood from Sandnes graveyard representing the Crucifixion with the Virgin Mary and St. John shown in characteristic pose. Although the figures are Gothic in style, the ornamentation is Romanesque. The wood is fir and driftwood, and the place of origin Iceland or possibly Norway.

(This photograph and the drawing below are reproduced by courtesy of Dr. Aage Roussell of the Greenland Research Commission.)

Some small carvings in bone and walrus ivory are interesting. Among them is a human head which gives in the heavy features and long upper lip an anything but flattering portrait of the Greenland Norse type. It serves to recall, however, the somewhat brutalised type of skeletal remains from the eastern settlement, to which reference has already been made.



Reconstruction of a movable bed from Umiviarssuk Farm. The size of the frame is 155 cm. by 95 cm. It may have had bottom boards, though there is no evidence of them, or the bed, composed of a mattress on straw and heather, may have rested on the floor. Similar movable beds are mentioned in the sagas, but fell into disuse in mediæval times, when beds were fixed to the wall; and they were not reintroduced until the XVIth century. Their use evidently lingered late in this backward community.

The wealth of the sites in smaller antiquities will be gathered from the fact that the expedition collected nearly 1,200 objects. Excavation was extremely difficult, and owing to the shifting of the soil under climatic conditions the Sandnes site was covered with midden. No stratification could be established. Objects of early date were often found superimposed upon those of a much later period. Owing to subsidence coast erosion is taking place, and part of the churchyard, and probably some of the farm outbuildings have been swept away. The church ruins also are disappearing.

The farm adjoining Sandnes Church, of which the name is unknown, was of considerable size, although many of the farms crowded along the waters of the fjord are so small as to raise question how they could support the farmer. The farmhouse itself was a solid

erection of stone with living, sleeping rooms, etc., and immediately behind was a series of substantial outbuildings for stock, of which they kept cattle, sheep, goats and pigs. A skeleton of a dog was found. This is the first Norse dog to be discovered. It had extremely long legs like a greyhound, but was of heavier build. The series of outbuildings also contained the farm workshop; and in the small finds from the floors, there is evidence which shows that some at least of the women farm servants must have slept there. The farm forge near-by provided samples of the iron used, which has afforded evidence for the first time proving that the early mediæval Scandinavians did actually produce primarily a steel, but that owing to their methods of further working, this lost its quality and hardness, so that the finished product was of soft iron only. The excavation of the churchyard produced virtually nothing in the way of grave furniture. Early interments had suffered much damage from disturbance by later burials, and skeletons had sometimes been cut in half. Evidence pointing with little doubt to an epidemic may, perhaps, indicate the cause which so weakened the settlement as to lead to its ultimate fate at the hands of the Eskimo.

"Infra-Red" and Psychic Research

The International Institute of Psychical Research has now developed a satisfactory technique of infra-red cinematography, and is in a position to investigate fully all psychic matters. This was the claim of Dr. Nandor Fodor, Research Officer of the Institute, who demonstrated several infra-red cinematograph films at a meeting on April 15th.

The main film comprised a record (taken in darkness) of a supposed medium causing a flower to jump out of a vase. When the film was taken, it was supposed that this was a psychic manifestation; the medium subsequently turned out to be false and the film was most useful in showing the exact means by which the medium lifted the flower with a length of cotton stretched between his wrists. The main result of this film was, however, to show that a close-up camera was necessary, as well as one placed some twenty-five feet distant from the medium.

The infra-red studio at Walton House, the headquarters of the Institute, has been re-arranged, and when the well-known Rudy Schneider visits the Institute in a few days' time he will perform his psychic phenomena under half-a-dozen infra-red lamps. These will all be operated by one switch, and one of the research workers will signal to the camera operator when psychic manifestations begin. The camera will be started in darkness, suddenly the lamps will be thrown on — and the materialised child's hand, which is Rudy Schneider's most common manifestation, will either break down, or will persist and its genuineness or fraudulence will be apparent. If the breaking-down occurs within two seconds some fifty frames showing it will be recorded.

In addition to this, infra-red flashlights will be fired automatically by the lifting of a trumpet or a basket, and every effort will be made to record any psychic manifestations which occur.

St. Helena

(*Continued from page 147*)

about 10¼ miles long and 8¼ miles wide. A high central ridge describes a semicircle from the south-east to the south-west, and separates the island into two parts. Diana's Peak (2,697 ft.) is the loftiest summit; the so-called High Peak is only 2,635 ft. high. Where the mountains strike the sea are cliffs, in places reaching 2,000 ft. in height. The well-known rock called Lot's Wife is a curious pillar 260 ft. high with an upper part considerably thicker than its base. Lot, some 290 ft. high, is further inland.

The island is of comparatively recent volcanic origin, geologically speaking, and some 70 lava flows can still be counted. A sharp division between two ravines called Friars Ridge illustrates the squeezing of a very compact lava. The curious conformation of the stone here, where a rock pillar 12 ft. high has a striking resemblance to a hooded friar, has given rise to a typical legend. It is supposed to occupy the site of a catholic chapel where the officiating priest was a Franciscan friar. He is alleged to have fallen a victim to the charms of a lovely shepherdess, and to have renounced his faith in order to marry her in the very chapel where he once had served. No sooner was the wedding service read than the chapel was overwhelmed by rocks; only the grim and gaunt outline of the friar remains as a reminder of the legendary island romance.

Jamestown, the capital of the island, lies in a narrow valley leading down to the sea. Here a church was built in 1857; the island is the headquarters of the Bishop of St. Helena, who was appointed in 1860. His remarkable diocese includes Ascension and the British residents of Rio de Janeiro and other "similar places" situated on the coast of South America.

Jacob's Ladder

One of the most remarkable feats of engineering on the island is the "Ladder," a flight of 699 steps 900 ft. long which rise from Jamestown to the heights above. The home of the Governor of St. Helena, known as Plantation House, is 3¼ miles from Jamestown; it was built in 1791 and stands, 1,791 ft. above the sea.

The principal occupation of the islanders is flax-growing, and passengers on passing vessels are familiar with the bead-work and lace-work made in Jamestown which is there offered for sale.

The history and landscape of the island are excellently illustrated on the recent series of pictorial postage stamps issued to celebrate the centenary of the passing over of the island by the East India Company to the Crown in 1834.

High Speed Steel

By E. Pasley.

Extra-hard steel plays an increasingly important part in modern life, and we are greatly indebted to the Editor of The Wild-Barfield Heat-Treament Journal, by whose courtesy we are able to publish this article by an eminent Sheffield metallurgist.

THE principal alloys used in the production of high speed steel are carbon, tungsten, chromium, vanadium, cobalt and molybdenum. Whilst all these metals have their effect upon the high speed cutting properties of the steel, it might be said that carbon and tungsten are the essential elements. It is worthy of note that the forerunner of high speed steel, namely, Mushet self-hard steel, employed these two metals or elements in considerable quantities, to confer the then new so-called red hardness. The progress since made in the production of " higher " speed steels has been attained by increasing the tungsten content and decreasing the carbon content and by the addition of one or more of the other previously mentioned metals.

Probably the high speed steel of which the preponderating tonnage is made, is of the so called 18-4-1 type. The figures indicate the percentage of tungsten, chromium, and vanadium respectively which the steel contains. and our description of the method of heat-treatment applies to this class of high speed steel. To refer back to the question of analysis it should be pointed out that in addition to the percentage of the three elements, tungsten, chromium and vanadium, certain modern high speed steels also contain cobalt, in amounts varying from one to eighteen per cent. and molybdenum from under one to two per cent. Attempts have been and are being made, particularly in the U.S.A., to replace the tungsten of high speed steels, either wholly or in part, by molybdenum.

Tungsten contributes to high speed steel the property of red hardness, in proportion to the amount present up to approximately fifteen per cent. and more slowly by increasing amounts above that percentage. So much is this true, that no steel is manufactured of comparable red hardness without tungsten.

Chromium would appear to have mainly a threefold effect upon high speed steel. (*a*) To increase the air and depth hardening properties of the steel. (*b*) To enhance the property of red hardness conferred by the tungsten. (*c*) To increase the carbide solubility at high temperature.

Vanadium undoubtedly further assists in the production of greater red hardness in the steel. It is also of use in reducing the risks of clinking or cracking during the heating and cooling which are necessary parts of the manufacturing processes.

Cobalt exists in solution with the iron. It is thought to increase the solution of the tungsten and the carbides, tending to produce a more intense red hardness and to increase the temperature range of the latter.

Carbon is mainly responsible for the characteristic martensitic mode of hardening. It is found that practically carbonless 18-4-1 alloys behave as precipitation hardening alloys which when quenched from high temperatures consist of ferrite and tungstide, and that increasing carbon content displaces the tungstide by the carbide Fe_4W_2C. Upon heating to temperatures above 1,200° C. this carbide dissolves in the austenite and is retained in solution upon quenching.

High speed steel is melted in the crucible, electric arc, or high frequency furnace. Good quality steels may be produced from any of the above melting units, provided they are worked in a skilled manner, with due regard to the metallurgical problems attaching to each type of unit, and that the selection of the raw materials is carefully undertaken. There is an increasing tonnage of high speed steel being melted in the high frequency electric furnace. The first major operation after the casting is the cogging or hammering of the cast ingots into cogged bars. This procedure is sometimes preceded by an annealing operation, which may be necessary owing to the size of the ingots or type of high speed steel cast. After the cogging operation the bars are cooled slowly, again annealed and surface-ground to remove such surface defects as have been introduced during the casting or subsequent cogging operations. Depending upon the dimensions of the final product, re-cogging and re-grinding may be necessary.

The steel is now in the state which serves as a jumping-off ground for the production of forged blanks and forged or rolled bars. The hot working operations just described are carried out within a temperature range of from nearly 1,200° C. down to almost 900° C. The bars or blanks are then annealed by heating to between 850° C. and 900° C. followed by a very slow cooling in the furnace. This operation reduces the hardness of the steel to between 217 and 260 Brinell hardness number, the ordinary grades of high speed steel being towards the lower figure and the special cobalt grades reaching upwards to the higher. The object of the mechanical hot working which has been outlined above is twofold, the first reason being the obvious one of reducing the ingot to the

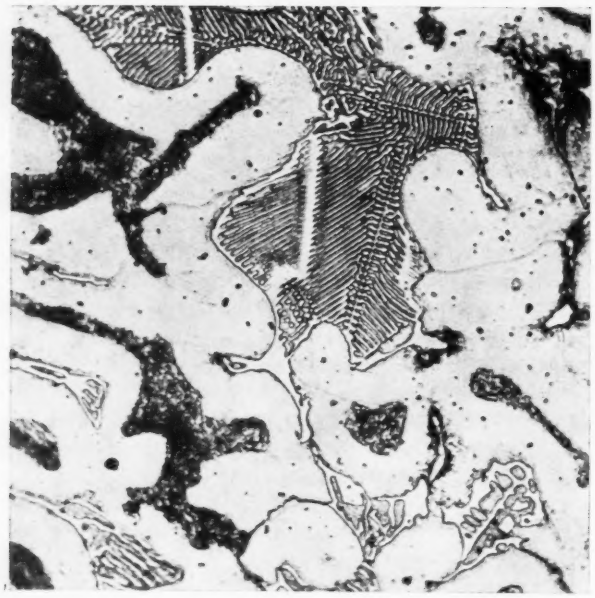


Fig. 1.

desired useful shape and dimensions. The second, and more important one from the metallurgical standpoint is the production of a fine grained steel, within which the carbides are as evenly distributed as possible. In the microphotograph Fig. 1 which is from an " as cast " section of steel it will be seen that the steel is composed of rather massive eutectic carbides in a cored matrix of austenite. Generally speaking the larger the ingot, the greater the coring effect and the more massive the carbide. The latter form brittle envelopes around the austenitic grains. These envelopes are the cause of the relative fragility of high speed ingots, necessitating great care in the heating and forging of them.

It is the breaking down of these herring-bone-like carbides into small globules, as evenly distributed throughout the mass as possible, together with the homogenising of the austenite matrix, which contributes so largely to the production of the very desirable mechanical properties of forged or rolled high speed steel products. The annealing of the bars has the effect of reducing the matrix, which existed in the forged condition as austenite, to the condition of spheroidised eutectoid carbide dispersed in ferrite. The eutectic carbide particles are practically unchanged by this treatment.

We have now reached the stage at which the steel comes into the hands of the tool maker and finally the hardener. With the production of many fine and expensive tools, the hardening of high speed steel has long left the state when it was considered only necessary to heat the cutting edges to a heat sufficiently high to cause them to commence to fuse, in order to produce a desirable cutting tool. It is now considered good and economic practice to use furnaces, built specially for the purpose and capable of accurate control, not only of temperature, but of atmosphere. The modern furnace, accurately controlled as it is, has eased the problem of hardening tremendously, particularly the hardening of repetition work. In the latter case the most suitable time at the most satisfactory temperature can be found to give the requisite hardness (or perhaps one should say the requisite structure) for a particular type of tool. By this means a very regular product is obtained. The characteristics which make the modern furnace so valuable for repetition work also make it extremely useful for special and individual tools, although in the case of the latter probably greater judgment on the part of the operator is called for.

The first step necessary in the hardening process is that of pre-heating the tools to a temperature

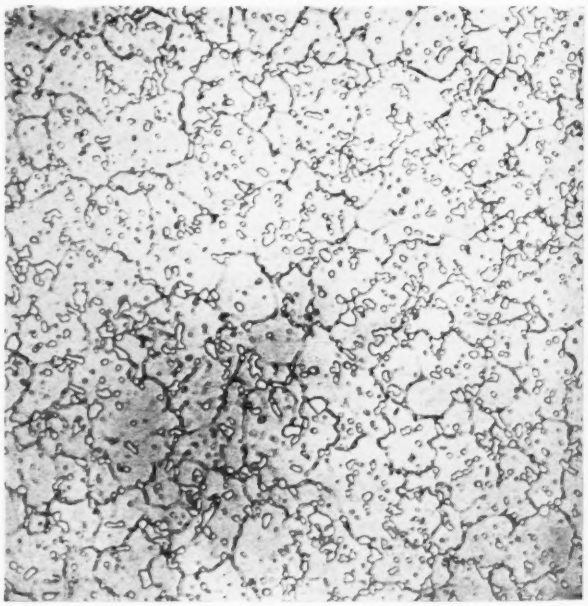


Fig. 2.

between 850° C. and 900° C. This is necessary chiefly because it ensures greater uniformity of heat throughout the tool when heated to the much higher hardening temperature, especially in tools having small sections or teeth projecting from a heavy body. Preheating is also necessary for those tools which are in the forged condition immediately prior to hardening. These tools may have a Brinell hardness of 500.

High speed steel in this condition has little capacity for plastic yielding and if heated rapidly to a high temperature, the temperature gradient produced would probably cause rupture. Furthermore the steel having been adequately soaked at about 900° C. has passed through the ferrite to austenite change, so that when heated to the hardening temperature no further dimensional change due to transformation, can come about. It is good practice to err on the generous side of time for the preheating operation.

The tool having been evenly preheated is transferred to the high heat chamber. Here, temperatures of 1,260° C. to 1,290° C. are employed. The tool should be allowed just to reach the temperature of the furnace if the higher temperature is being used. If the lower temperature is employed a short soak may be beneficial. After the above conditions have been fulfilled

Four microphotographs (x1000) *of* 18-4-1 *high speed steel etched in aqua regia and glycerine, as cast* (*fig.* 1), *hardened in oil at* 1,270° *C.* (*fig.* 2); *at* 1,320° *C.*; (*fig.* 3) *and at* 1,330° *C.* (*fig.* 4).

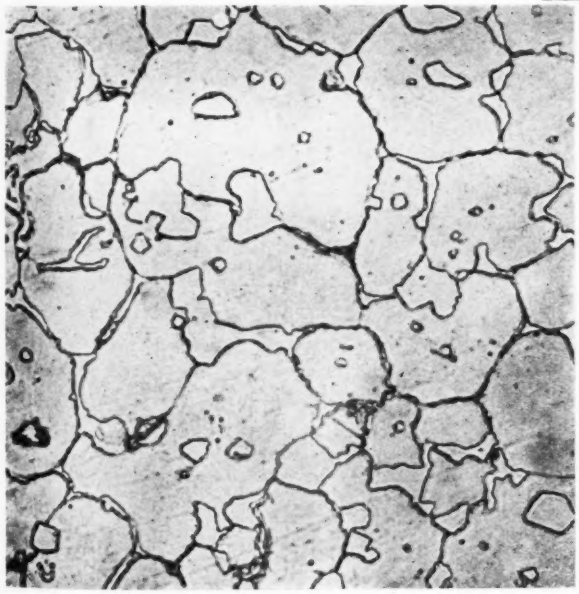


Fig. 3.

the tool is withdrawn from the furnace and either quenched in oil or blown cold. The time required to heat a tool depends upon the size of the tool and the heat capacity of the furnace. This time may vary from thirty seconds for a quarter-inch tool bit, to four or five minutes for a tool with a section of one and a half to two inches thick.

Whilst it is general practice to quench high speed steel in oil, it is not necessary to cool the steel rapidly

Fig. 4.

in order to retain it in the hardened condition, due to the extreme sluggishness with which the transformations take place. No great differences in the cutting abilities of the steel are noted whether the tools are oil quenched or air cooled. The writer's choice is usually that of oil quenching, as it offers a uniform rate of cooling, without requiring the exercise of unusual care. It is much more important that the accuracy of the high temperature measurement and the uniformity of the heating be maintained.

Many claims have been put forward for the control of the atmosphere in the furnace chamber. An obvious advantage in the adoption of an inert atmosphere is the reduction of the amount of scaling which takes place. This in itself means cleaner and better finished work, smaller grinding allowances and, in so far as the furnace itself is concerned, less severe corrosion of the refractory hearth. A second claim is that less grain growth takes place under given conditions in a suitably controlled atmosphere than in a chamber of hot air, in the case of the electric furnace, or of the products of combustion, in the gas or liquid fuel furnace.

The tempering of high speed steel is primarily undertaken to give maximum secondary hardness. This is obtained by heating for a considerable time, usually about an hour, to a temperature between 560° C. and 590° C. The writer has found 570° C. to be a very satisfactory temperature when carried out in a forced air circulation furnace. This type of furnace is exceedingly useful and economical for the production tempering

at temperatures up to 650° C. Tempering to obtain maximum toughness, albeit with some sacrifice of cutting efficiency, is sometimes required, and may be carried out at a temperature of 250° C.

The metallography of the hardening of high speed steel is in some particulars complex, but may with some satisfaction be regarded in a similar manner to the hardening of high carbon (hyper-eutectoid) steel. Although the temperatures used are different from those used when hardening carbon steel, the solution of the carbides and the production of analogous constituents are essentially the same. The process of hardening high speed steel, therefore, has for its object the solution of the complex carbides existing in it and their retention in solid solution, with the attendant production of austenite.

We have previously seen that high speed steel in the annealed condition consists of a matrix of ferrite in which were disposed innumerable spheroids of carbide, some smaller and some larger. The smaller spheroids are capable of being dissolved in the ferrite during the period of heating to the high temperatures employed, whilst the larger ones, which were produced by the mechanical breaking up of the eutectic carbides (of typical herring-bone structure, see fig. 1) are not. In fact, if the steel is heated sufficiently highly, these carbides fuse rather than go into solution. If this occurs, they tend to reproduce the herring-bone structure almost identical in form to that of the cast state.

Effects of Great Heat

By heating to almost 1,300° C. a large proportion, if not all, of the smaller carbides are dissolved. Because of the sluggishness of their precipitation they are retained in solution, at even so slow a rate of cooling as is obtained in still air. The solid solution thus retained when cold is named austenite, but if deeply etched often reveals the presence of martensitic markings. The shape and position of the larger undissolved carbide particles are a very good guide as to the correctness or otherwise of the hardening treatment. The micro-photographs, figs. 2, 3, 4, illustrate this point. If the smaller particles visible in the microsection are few, the larger carbides separate and irregularly nodular in shape and the grain size small, the steel has been satisfactorily treated. If the larger particles of the eutectic carbides show signs of coalescing, then the temperature of hardening has been a little too high. A further stage which may be observed is that at least some of the carbides assume an angular form, whilst still higher hardening temperatures cause these carbides to commence to fuse, firstly around the crystal boundaries, and then at the crystal junctions in the now familiar "herring-bones."

The two latter conditions of the eutectic carbides are usually accompanied by grain growth. Slight grain growth is not nearly so detrimental as is sometimes supposed. However, very large grains should be avoided. They are more of an indication of too long a time at the hardening heat than of too high a heat. The mechanical hardness of high speed steel is dependent upon the amount of the complex carbide in solution. At as low a temperature as 900° C. the ferrite-austenite change is accomplished, but the amount of carbide actually soluble at this temperature is very small. Increasing the temperature of the steel to above 1,200° C., results in augmenting the quantity of carbide dissolved, up to approximately .45 per cent. at 1,300° C. As all high speed steels contain considerably more carbon than this amount, residual carbide is always present in the hardened condition. The increasing solution of the carbides with increasing temperature accounts for the necessity of heating high speed steels for hardening purposes to temperatures some hundreds of degrees centigrade above the ferrite-austenite change temperature.

The heat treatment of the more highly alloyed high speed steels, such as those containing high percentages of cobalt, follows similar methods to those described. The metallurgical considerations are also similar. The variations from normal practice are more questions of greater care in heating and cooling, together with minor changes in the temperatures at which the operations are performed.

Books Received

Scandinavian Archæology. By HAAKON SHETELIG and HJALMAR FALK. (Oxford Univ. Press. 21*s.*)

The Irish Countryman. By CONRAD M. ARENSBERG. (Macmillan. 10*s.* 6*d.*)

Cricket as Allied to the Heavens. By "DWARPA." (A. H. Stockwell, London. 2*s.*)

What Science Stands For. By SIR J. B. ORR, A. V. HILL, J. C. PHILIP, SIR R. GREGORY, SIR A. P. HALL, and L. HOGBEN, FF.R.S. (Allen and Unwin. 5*s.*)

The Scenic Heritage of England and Wales. By O. J. R. HOWARTH. (Pitman. 8*s.* 6*d.*)

In Quest of Gorillas. By W. K. GREGORY and H. C. RAVEN. (Darwin Press, New Bedford, Mass. $3.50.)

Legendary London. By LEWIS SPENCE. (Robt. Hale. 12*s.* 6*d.*)

Half Caste. By CEDRIC DOVER. (Secker and Warburg. 10*s.* 6*d.*)

The Newer Alchemy. By LORD RUTHERFORD. (Cambridge University. 3*s.* 6*d.*)

British Health Resorts, 1937. (British Health Resorts Association. 2*s.* 6*d.*)

Life in the Animal World. By F. H. SHOOSMITH. (Harrap. 5*s.*)

Science Front, 1936. By GERALD HEARD. (Cassell. 5*s.*)

Hunting Beasts and Men. By P. H. COMBE. (Robert Hale. 12*s.* 6*d.*)

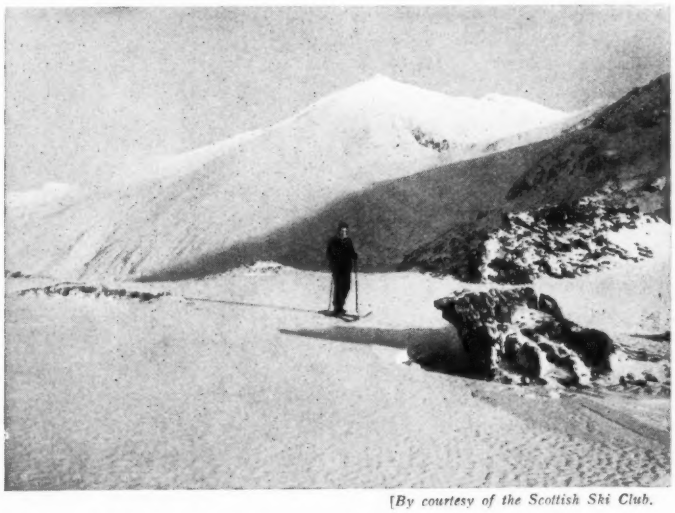
The Soul of Nigeria. By ISAAC O. DELANO. (Werner Laurie. 10*s.* 6*d.*)

Snowfall in the British Isles

By L. C. W. Bonacina, F.R.Met.Soc.

This article, based on a paper read in London on December 11th, 1936, at a meeting of the British Section of the International Snow Commission, deals with the behaviour of snow in this country, and the methods by which it is studied.

In the course of visiting every county in England, and some in Scotland and Wales, I have never lost an opportunity to question the local people about snow. Their information has helped to impress upon me the fact that in Great Britain there is a marked inequality between snowfall in the hills and in the plains. From sea-level up to about 500 feet snowfall is very irregular and seldom heavy or long-lasting; but upwards of 500 feet it rapidly tends to become heavy and frequent, sometimes taking the form of drifting blizzards, the severity of which the lowland city dweller can hardly conceive. This contrast is more marked here than on the neighbouring Continental mainland, because there deeper frosty layers of temperature inversion are less easily swept away by incursions of warm moist air, so that more snowfalls can reach sea-level. It is due partly to the general increase of precipitation with the height of the land, but is in greater measure due to the critical level of winter temperature in the British Isles connected with warm Atlantic water to the westward, which causes most of the moisture to descend as rain at low levels. Hence it happens that Londoners, who only see a real snowfall once in many years, and are robbed by the artificial conditions of a vast city of the sight of many lighter falls that every year come to the outlying suburbs, are apt to assume quite wrongly that there is little or no snow in England.



[By courtesy of the Scottish Ski Club.

A typical March scene at the summit of Ben Lawers. The cornice to the right of the summit on a southerly slope has probably been formed by snow carried across the plateau behind in the fierce Northerly winds.

In the English edition of Reclus' famous *Universal Geography* the situation with regard to the British Isles is quite well summed up in the statement: "Snow and ice are, of course, known, and the amount of the former which occasionally falls in Northern England and in the Scottish Highlands is great." It must be remembered, too, that something like half the area of England and Ireland, and three-quarters that of Scotland and Wales, is over the critical level of 500 feet, with corresponding bleak weather. There are outlying villages and hamlets in the High Peak district of Derbyshire, and sheep farms tucked away in wild folds of the Cheviot Hills, where they have told me that neglect to lay up provisions during the month of October might mean starvation at any time afterwards. It is a climatically significant fact that the literature, folklore, and even local turns of speech of the British Isles abound in references to snow and are rich in its imagery.

All the mountainous areas of Britain need special study in relation to drifting. It is a highly critical factor in the snowfall of this country, and that, in the case of the Grampian summits which come near the limit of perpetual snow, it appears to be the determining factor in preventing the formation of small glaciers at the present time. In order, however, to throw the more specific problems of the Highlands into sharper relief it is well to note that gigantic snowdrifts after exceptional storms have been known to linger till midsummer in the hills of the South of England, not only on Dartmoor and Exmoor, but even on lower ranges like the Cotswolds and the Downs. It would

seem, moreover, that artificial snow-heaps are relatively even more tenacious than the great natural drifts of the bleak hills ; for I have in my pocket-book an astonishing newspaper record to the effect that snow collected in London after the blizzard of January 1881 was in evidence as late as the following July in what was, till this century, the age-long dumping ground of the City, namely, Finsbury Circus. The endurance of lumps of old snow in an apparently unfavourable environment is in itself an interesting subject for investigation.

At elevations exceeding 2,000 feet in Britain the lingering of snowdrifts from winter to summer ceases to be the occasional aftermath of some erratic blizzard, and tends to become a habitual phenomenon of the ordinary seasonal snowfall. On Carnedd Llewelyn in the Snowdon range there is a gully, facing south, but favourably situated to catch drift from all quarters, which was shown by the late Mr. Gethin Jones habitually to retain snow till July. This gully holds as much snow as its dimensions will allow, and if deeper, might hold it permanently. Mr. Gethin Jones' death many years ago was a great loss to Welsh mountain meteorology, and it is to be hoped that another equally enthusiastic Welshman will eventually arise to carry on his work. The Lake District is also a field for the investigation of late snowspots. In this connection I may recall that in Wordsworth's little poem entitled *Fidelity* whose scene is the rugged side of Helvellyn there is reference to a " cove, a huge recess that holds till June December's snow "—which conjures up in a couple of lines a vivid climatic picture against the somewhat austere background of the higher fells of Cumberland and Westmorland.

In the Highlands of Scotland late snowdrifts in spring are an integral part of the landscape whose wild beauty and romantic history can hardly be thought of without their abiding scenic influence. Many at the higher levels in the main Grampian mass, and also in Rossshire, linger till mid-summer, a few here and there persist through some summers till reinforced in the autumn, and at least two, one in the Allt-a-Mhuilinn corrie of Ben Nevis, the other in the Garbh Choire corrie between Braeriach and Carn Toul in the Cairngorms, are virtually permanent, vanishing only about once in half a century.

It is desirable to ascertain whether the snow-beds in the corries and gullies, particularly the nearly permanent ones of Ben Nevis and Braeriach, are fed by a large or small proportion of the snow lost to the encircling mountains either by drifting or avalanching from cornices. A knowledge of this relationship would help to throw light on the glaciological significance of the Highland snowfall as a whole. If, as the evidence suggests, the larger proportion of the snow blown from the summits and ridges is not deposited in the high-level corries, but is driven for miles till finally dispersed in the lowlands to leeward, this may be the critical factor in preventing the formation of small glaciers in the Highlands to-day. Snow dispersed by the wind to low levels soon disappears under present climatic conditions, and no doubt the numerous Highland lochs entrap much blown snow, disposing of it there and then.

It should be evident that small snowfields of a permanent or semi-permanent character must be much more sensitive to the climatic rhythm from year to year or century to century than fully developed glaciers which, though integrating a wide range of climatic influences, respond to variation much more sluggishly. Had our predecessors recorded the size and condition of the Scottish beds in relation to weather conditions we should have had a climatic index through the centuries of priceless value. Hence we should see to it that our successors through the centuries have this index. The disappearance of the Braeriach snow in the autumn of 1933 and of both the Braeriach and Ben Nevis snow in 1935 are said to be the only occasions in living memory. The determining factor in 1933 appears to have been warm rains in August after a hot summer, and in 1935 warm rains in September after a winter when accumulations of snow began very late in consequence of the very warm December of 1934.

By courtesy of the Royal Meteorological Society.

Snowdrift at Shirenewton Hall, Monmouthshire, March, 1891. This photograph is particularly instructive as it shows the formation of a snow cornice by the action of the wind. The clear space in front of the cornice is most likely due to a suction-eddy. This was the occasion of the memorable West of England blizzard, March 9th-12th, 1891, when many trains were blocked and even buried, especially in Devon and Cornwall.

There has been a good deal of controversy since the turn of the century among keen amateur investigators as to the physical condition of the snowbeds, whether they are merely hardened snow, or true *firn* or actual glacier ice. The fact that both the Ben Nevis and Cairngorm snow vanished for once in 1935 suggests that all three conditions may obtain in turn. Unfortunately I was unaware of the disappearance of the snow in 1935 till too late to ask interested persons visiting Ben Nevis early in the autumn of 1936 to investigate the condition

[*Photograph by Mr. Gordon Manley*

A road being cleared in Upper Teesdale in the Northern Pennines at an altitude of about 1700 *feet, after the severe blizzards of March this year. Long stretches of this road had snow* 12 *feet deep.*

of the Allt-a-Mhuilinn bed, be-sides reporting its survival The information might have answered the question whether *firn* or *neve* can form in a single year.

It is maintained by Professor Ahlmann that hoar-frost and rime contribute largely in addition to snowfall to the maintenance of the Svartisen and other mountain glaciers of Norway. In the somewhat similar climate of the Scottish Highlands rime or frozen fog-drip and that form of hoar-frost which is due to the impact of damp winds against a cold surface, are important phenomena. It is consequently a subject for research how far these sublimation processes supplement direct snowfall, drifting andavalanching in the maintenance of the Scottish snowfields. It is doubtful whether these snow and ice sheets are such active collectors of rime and hoar as projecting spurs and slabs of rock.

It is obvious that these problems could much more easily have been tackled were the Ben Nevis Observatory still in being. Happily, however, quite a number of people in the north appear to be interested in the subject, and we may be sure of the enthusiastic support of flourishing associations such as the Scottish Mountaineering and Ski Clubs. Finally, I should like to suggest that if it is proposed is to establish snow gauges in the Highlands, it would be well to put one in the Allt-a-Mhuillin corrie referred to above. This corrie has long been suspected of receiving the heaviest precipitation in the whole of the British Isles, but it has never been possible to set up a rain gauge there to test the supposition just for the reason that the corrie is liable to be choked up with snow for long periods. It should, moreover, be remembered that the corrie is a place of mystery, with so many disturbing elements due to eddies and deflection of air-currents as to leave us somewhat in doubt as to what theoretically we really want our precipitation gauges to measure. Unfortunately the measurement of drifting snow presents difficulties not only in practice but also in theory.

If a satisfactory type of snow-gauge, with elimination of eddy disturbance, were devised, it would certainly catch drift as well as snowfall, and the question arises whether this would not be a perfectly legitimate function of the gauge. In cases of heavy drifting should the snow on meteorological and hydrological grounds be credited to the spot where it first falls only to be blown away again, or to the spot sometimes miles away where it finally comes to rest. It is sometimes found, for instance, that after a severe drifting snowstorm generated by the high ground of Cross Fell Edge, Snowdon or Dartmoor, the bulk of the snow is found in the low country to leeward. It seems to me that in face of such anomalies the entire question of the meaning to be attached to the fall of snow and its measurement requires nothing less than a full-dress debate at another meeting of the British Snow Commission.

Correspondence

(*Continued from page* 160)

IMAGINATION AND WORDSWORTH.

To the Editor of DISCOVERY.

Sir,—The article on *Imagination: Shakespeare and Wordsworth* in the April number of DISCOVERY is based on a false premise. The fact that Wordsworth actually wrote "Poetry takes its origin in emotion recollected in tranquillity" vitiates its whole argument. Mr. Higgins substitutes "imagination" for the first word in the sentence and, having demolished his own paraphrase, goes on to agree that "emotional recollections" may "probably" be the "parents of inspiration"!

Half a dozen lines lower down he again misquotes from *The Solitary Reaper*. His "The old far off unhappy things, and battles long ago" misrenders the poet's

"For old, unhappy, far-off things
And battles long ago:".

However, this error does not affect the argument—only the poetry.

Yours faithfully,

EDITH J. MORLEY.

University of Reading.

Correspondence

"WHERE DISCOVERERS WERE WRONG."

To the Editor of DISCOVERY.

Sir,—The interesting article entitled "Where Discoverers Were Wrong," by Professor D. F. Fraser-Harris, which appeared in the December number, opens up a number of interesting considerations as to the nature of, and the cause for, the limitations in the purview of great minds. That all minds, even the greatest, have their limitations and their "blind spots" is abundantly proved by the study of the history of science. In many cases these are merely examples of the increasing stiffness of the working of their mental machinery with advancing years, common, in a greater or less degree, to all minds. I think, however, we do an injustice to genius if we fail to recognise that many of the so called "errors" of the great men of science have been due to the fact that they saw further than their contemporaries, and that they were actually grappling with problems which were not yet ripe for solution, as they could not be integrated into the body of science in its then stage of development, and only served to confuse the immediate issues.

The classical example is, perhaps, Newton's rejection of the undulatory theory of light. Newton recognised that a ray of light exhibited alternating phases (or "fits," as he called them). The phenomenon of double refraction in Iceland Spar showed that the phases concerned opposite sides of the ray, so that if they were due to wave motion, it must be a wave of transverse vibration. But he knew that transverse waves could not occur in media, but only on surfaces. He was therefore driven to the conclusion that light was of a corpuscular nature, but was accompanied by vibrations in the æther through which it was passing. The justification for this view only emerged when Planck stated his "Quantum Theory" in 1901, which implied that the structure of light was both corpuscular and undulatory, but in the meanwhile Newton's theory had held up the development of the undulatory theory for over a hundred years.

A similar argument may be advanced in justification of the advocates of "phlogiston," from Stahl to Priestley. To them it seemed that a chemical reaction was much more than a mere interchange of component parts between the reagents. A development, or an absorption of heat was in many cases the most striking feature of the reaction, and this, they felt, was equally worthy of study. As the concept of *energy* had not yet emerged, it was natural for them to regard the thermal changes as due to the displacement of a substance, or entity, which they called "phlogiston," which corresponded to what we now call energy. But the phlogiston theory was an untimely development, and hampered the immediate business in hand, which was to interpret chemical change in terms of the indestructability of matter. It was to find justification some fifty years after Priestley, when the doctrine of conservation of energy began to be applied to chemical equations; but, though justified, it has never received justice.

Instances might be multiplied almost indefinitely. We might cite all the most penetrating speculation of the Greek natural philosophers. In recent times we can point to Liebig's controversy with Pasteur over the nature of "ferments." Pasteur, bent on practical applications, insisted on the view that fermentation and putrefaction were due to the vital activity of micro-organisms. This was one of the most fertile ideas which had ever emanated from the brain of man. Liebig (and also Claude Bernard) objected that fermentations could be brought about by the action of enzymes, such as diastase, which were chemical substances, separated by solutions from living cells, and that such action was obviously chemical, and not vital. He was, of course, right, but the point was of little practical importance when it was raised, and it had the unfortunate effect of giving a handle to the opponents of the "germ theory" of putrefaction and disease, and delaying its general acceptance. Pasteur's magnificent demonstrations succeeded in brushing aside this theoretically correct, but at the time irrelevant, objection, and his teaching has had the result of transforming medicine from an impotent and tentative art into a positive and progressive branch of science.

It would seem that there is a certain order to which the evolution of the leading ideas of science must conform. Those that emerge prematurely are apt to be still-born, and only obstruct the orderly progress of science. None the less, in the end, "Wisdom is justified of all her children."

Yours faithfully,
G. WILKINSON.

Sheffield.

RIGHT OF WAY ROUND THE COAST.

To the Editor of DISCOVERY.

Sir,—In a review of Dr. Vaughan Cornish's "Preservation of our Scenery" (in the March issue), your reviewer remarks: "Dr. Cornish is, no doubt, aware of the fact that a public right-of-way has long existed all round the coasts of Great Britain: even this has become rather a problem with owners of long-established houses and grounds near the cliff edge."

It would be interesting if the grounds on which the existence of this right-of-way is so confidently asserted could be stated. The prevailing impression in Lincoln's Inn is that the existence of a general right-of-way, even over the foreshore (*i.e.*, below high-water mark), was negatived by the Court of King's Bench more than a hundred years ago, and by the Court of Appeal some eighty years later; and that (although there are, of course, many places in which there is a local right of way along the cliff edge) nobody has ever been bold enough to claim that there is a right to pass, on foot or otherwise, "all round the coasts of Great Britain."

Yours faithfully,
N. C. ARMITAGE.

Old Square, Lincoln's Inn.

To the Editor of DISCOVERY.

Sir,—I regret that my statement that "there is a public right-of-way all round the coasts of Great Britain" is incorrect. I made it in all good faith, having been told in early youth that this was so. From what I can gather, it appears that the foreshore, between high- and low-water mark, is mostly Crown property; but even the beach is private in a few places. Here I will leave the subject, for the ignorant must walk warily amid these quicksands and stretches of shingle!

Yours faithfully,
THE REVIEWER.

(*Continued on page* 159)

Book Reviews

Discovering France

France: A Companion to French Studies. Edited by R. L. GRAEME RITCHIE. (Methuen. 16*s*.).

A Frenchwoman once wrote a book on England with the apt title of "L'Ile Inconnue." Professor Ritchie and his team of writers have now returned the compliment by giving us a book on that scarcely better known country—France. It may fairly be described as a detailed and scientific exploration of French civilisation and culture, of which far too little is known in this country. It should therefore have a special appeal for the readers of DISCOVERY. Believing apparently that he who tries to embrace too much, gets a poor grip of his objective, the editor has deliberately ruled out many important topics, such as religion (a truly thorny subject), music, science, and many others, and has concentrated on French thought, history and literature (from the 17th century), institutions, architecture and painting. The only subject whose absence one regrets is science, especially as it has long formed an integral part of French culture; there is nothing like the same gap between the two as is to be found in this country. An Academy of the Sciences has existed in various forms since the 17th century in close relationship with the Academy of Literature, and is one of the five Academies which are housed under a single roof, the cupola of the Institute. The liaison was also maintained and strengthened by the "bluestocking" salons of the 17th and 18th centuries; so much so that though there is no separate chapter on the subject, science slips in from time to time, as when Descartes, Fontenelle, or the English Newton come under discussion.

But apart from this partial omission one can only unreservedly marvel at the wealth of facts and facets that the editors display before us. Probably the pick of the bunch are the admirable chapters by the editor himself. In the first on the country, people, and civilisation, he stresses the all-important point that French unity is derived from civilisation and not from race; even nationalism comes later with Joan of Arc. He rightly insists also on the extraordinary attachment of the French to the soil, due to the fact that France is one of the oldest of inhabited countries, as the Cro-Magnon and Mousterian settlements show. Equally striking are the chapters on French history in the 17th century, and French history and literature in the 18th century. The first is full of that bold yet subtle relief that suggests a complete mastery of the subject. In the second the interactions of the two subjects are worked out in a similar masterly fashion, and prominence is rightly given to the influence throughout the period of "the English Ideas," often strangely transmogrified by those who introduced them. Of the chapters on architecture and painting, possibly the most remarkable comment is the somewhat hard saying that French architecture has done nothing for the last hundred and fifty years apart from a few admirable artists. Both articles, like the other chapters of the book, suffer only from comparison with the outstanding ones already mentioned. *Le mieux est toujours l'ennemi du bien.* CLOUDESLEY BRERETON.

Looking Behind the Sagas

The Vikings of Britain. By D. P. CAPPER. (Allen & Unwin. 7*s*. 6*d*.)

Mr. Capper has performed a useful service in disentangling (so far as is possible) the history and legend of a period of British history about which the whole truth will probably never be known. The age of the Vikings, which endured from 787 until the reign of Henry II, depends for its elucidation mainly on a number of sagas, which, as might be expected, use the privilege of poetic licence to a considerable extent. Many of them, however, have the advantage of having been composed by the man on the spot, as the skalds who first sang them accompanied their chiefs in battle and foray and had first-hand knowledge of their subject.

The Vikings were too individualistic to make their history easy to reconstruct. The Earldom of Orkney, the key-position of the Norsemen's power in Britain, owed only a very sketchy allegiance to Norway, and the Earl of Orkney at any given time was just as likely to be fighting against his overlord as for him; and the various Olafs, Swains (this is Mr. Capper's favoured way of spelling it), and Hakons are in alliance or at enmity with each other in a kaleidoscopic series of changes.

At all events Mr. Capper makes it clear that the three main foci of Norse rule in Britain were Orkney, York, and Dublin, and he reveals clearly the intangible link that bound the last two centres together. A chapter is inevitably devoted to the expeditions to "Vinland the Good," though the connection of these with the British Vikings is of the slenderest; best of all is the sketch of St. Magnus, in whose martyrdom the real greatness of the Norse character is revealed. The high level of Norse art (and especially shipbuilding), the character of the berserker, the lightness with which the duties of Christianity lay upon the converted Vikings, and their real, if somewhat spasmodic, chivalry towards women are only a few of the interesting points treated with a scholarship that is never dry. JOHN LAMB.

Do Birds Think?

Bird Behaviour. By F. B. KIRKMAN. (Nelson. 7*s*. 6*d*.)

The study of bird behaviour has progressed enormously in the last twenty-five years. This book, which relates, and illustrates by photographs, the author's intensive observations of black-headed gulls over some thirty years, is of definite importance. The first eight chapters deal with the breeding habits of this species; their nest-building and brooding, their various notes, their attitude towards intruders, their treatment of their own and other gulls' nestlings. In the ninth Mr. Kirkman considers the mentality of gulls, and in the following three gives the results of tests of their reactions as regards their nest, eggs and nesting material.

He assumes that this gull has a mind, that it is "capable of perception, recognition, feeling, striving." Some idea of what its mental processes are can be inferred from its behaviour, but in drawing such inferences two important rules must be observed. First, the soundness of each hypothesis must be tested by reference to its necessary consequents; and second, no action must be interpreted as a higher psychological process if it can be interpreted as one lower in the scale. This is known as "the Lloyd Morgan canon." Mr. Kirkman found that when the behaviour of these gulls was thus tested it was evident that they are incapable of foresight, and of making plans accordingly. The species holds its own in the struggle for existence by other means, *e.g.*, by congenitally determined behaviour.

These conclusions he confirmed by experiments. When an alien egg was placed just outside a gull's nest, each bird rolled it into its nest: the action was instinctive. But if these conditions were modified the results were different. When all a bird's eggs were placed one and a half feet from the centre of the nest, out of twenty-six gulls thirteen rolled an egg or eggs back to the nest, one sat on the eggs and built a nest round them, eight showed varying indecisive reactions, and four ignored the eggs altogether. There were "differences in innate capacity"; the thirteen and the one reacted either to the eggs or the nest; eight hesitated between the urge to roll and the urge to incubate, and four failed to perceive any relation between the eggs and the nest. (On the same analogy a herring gull has been observed to kill and swallow one of its own young that strayed from the nest.)

In another set of experiments, called "the triangle tests," the eggs and the nest lining were removed to separate points each one and a half feet from the nesting site, the three thus forming an equilateral triangle. Of twenty gulls, one rolled the eggs to the lining, two rolled the eggs to the site, twelve sat on the eggs and built a new lining round them, and five failed to complete either the sitting or rolling action. Thus some birds reacted to the lining as "own nest," others reacted to the site, and others to "nest with eggs," though there was no nest round the eggs. The remaining five were evidently confused, and failed to relate the eggs either to the site or to the lining.

Elsewhere Mr. Kirkman has classified animal behaviour as instinctive, intelligent and rational; or, to use a more recent terminology, primary, secondary and tertiary. These observations and experiments are further evidence that practically all bird-behaviour belongs to the instinctive or primary category. It follows a pattern; any deviation from this confuses and puzzles; reactions differ according to individuality.

Mr. Kirkman's studies also extended to the reactions of these gulls to fear, anger, and sex. With regard to the last-named, he asks whether the "mutual attachment" of mated pairs should be "regarded as corresponding, however remotely, to what we mean by conjugal affection, as distinct from sex-feeling or passion," or as representing surplus energy or elation. The answer to this and other questions demands, he says, a comparative study of many species. This book marks an advance in our knowledge of bird-behaviour. The same methods of intensive study, if applied to other species, would yield equally important results.

E. W. HENDY.

The Constants of Nature

Relativity Theory of Protons and Electrons. By SIR A. S. EDDINGTON, F.R.S. (Cambridge University Press, 21*s*.)

During the present century classical mechanics has developed along two widely divergent lines. On the one hand, atomic phenomena have given rise to quantum mechanics; on the other, the gravitational motions of massive bodies have been most perfectly described by the general theory of relativity. These two theories are mathematically quite distinct, their only bond being reducibility by very different approximations to Newtonian mechanics. Sir Arthur Eddington has now proposed a unification of quantum mechanics and general relativity by means of a generalisation of quantum theory. He starts from a theory appropriate to protons and electrons, the development of which frequently presents him with alternative mathematical possibilities. On every such occasion, the choice is made by an appeal to general relativity. The truth of the latter theory is therefore assumed *a priori* and is not deduced from the "atomic" theory of bodies of large mass regarded as combinations of multitudes of protons and electrons.

Having completed the mathematical structure, the author turns to the physical consequences arising from such a unification of the two theories. These he finds in the purely deductive values which his theory enables him to give to one or more of the constants of nature in terms of the others. The constants concerned are the masses and charges of protons and electrons, Planck's constant, the velocity of light, and the constant of gravitation. The guiding principle here is that the relations between these constants are in a sense purely subjective. They arise from the possibility of describing the same physical state of affairs in different mathematical ways. For instance, the system formed by an electron and a proton is describable *either* as consisting of two separate entities *or* as a single proton-electron entity. The transition from one mode of description to the other throws up an equation giving the ratio of the masses of the electron and the proton. This is found to be 1847.6 and is slightly greater than the observed value. Again, consider a system of two similar particles attracting each other electrically according to the inverse square law. Interchange of the two particles should produce no physical alteration of the system. In the quantum equation describing this two-particle system, Sir Arthur Eddington shows that the "interaction term" arises from the indistinguishability of the particles concerned. Simultaneously he obtains for the relation between Planck's constant, h, the charge of the electron, e, and the velocity of light, c, the equation

$$\frac{hc}{2\pi e^2} = 137$$

As a third illustration, the theory of the whole universe may be worked out either by general relativity or by generalised quantum theory. Comparing the results obtained by the two methods, a value can be found for the total number of particles in the universe. This turns out to be N where $\frac{1}{2}N = 136 \times 2^{256}$

The foregoing deductions from the theory are so novel and of

such great importance that attention is inevitably focussed on the axioms on which it is based and which lead up to these consequences. In particular, most of the results involve a certain process by which the " times " of the constituent particles of a system are combined to give the " common time " of the system as a whole. This process, it must be said, would not be accepted by many mathematical physicists. Nevertheless, given Sir Arthur Eddington's premises, the whole theory is an astonishing feat of deductive reasoning which may, in the future, open up an entirely new branch of physical theory.

G. C. McVittie.

An Opti-Pessimist on World Catastrophe

Progress and Catastrophe. By Stanley Casson. (Hamish Hamilton. 7*s.* 6*d.*)

Mr. Casson, possessing an inexhaustible fund of archæological knowledge coupled with a very shrewd perception of the world as it is, is better fitted than most of us to compose " an anatomy of human adventure," as he describes his latest and most stimulating work. He claims to write neither as an optimist nor as a pessimist, but to present simply a record of such prehistoric and historic facts as are relevant to the state of civilisation to-day. But from the ominous sketch on the dust-cover to the last couple of plates (which illustrate some modern conditions) the book can fairly be regarded as a warning. " Timely warning " we would have said, but Mr. Casson himself declares his warning to be too late. Western European civilisation, he claims, has already collapsed, and such of us as believe it may be redeemed are living in a fool's paradise. Like Sidonius and his friends we are simply shutting our eyes to the omens of disintegration that surround us. We are allowed one grain of hope, however. Mr. Casson justly points out that a true internationalism does actually exist to-day—in the world of learning. When a conference on some subject, scientific or literary, is to be held, customs barriers, passport annoyances, and currency regulations fall into abeyance, and the business of the meeting is carried on in a really civilised way. It may be just possible that our administrators may see the advantages of such a system in ordinary everyday matters.

Out of the wealth of his scholarship Mr. Casson makes an admirable selection of facts appertaining to his case. The two great collapses of civilisation in the Western World occurred roughly in the 12th century B.C., and the 5th century A.D.—and the circumstances surrounding them were entirely different. The Minoan-Mycenæan civilisation was abruptly and almost completely obliterated ; the Roman simply fell to pieces from decay. But in both instances about four centuries of barbarism ensued. Though he does not say so, we cannot help feeling that Mr. Casson places us to-day in the approximate position of Sidonius Apollinaris, whose letters he so aptly quotes.

Mr. Casson's hero is Alexander the Great, the first, and so far the only leader to create an approach to an international civilisation ; and true internationalism, he contends, is the only perfect safeguard against periodic returns to barbarism. Fascism, in its ultra-national aspect, is the villain of the piece, and in this connection Mr. Casson's challenging square brackets burst like bubbles at unexpected intervals throughout the text. Is it not possible, however, that the fascist philosopher agrees with Mr. Casson that our civilisation has already collapsed and is trying to evolve something else that is not pure barbarism ? One or two of the author's slashing attacks on fascism leave him with a badly exposed flank.

These are small matters, however, and simply serve to season a remarkable piece of work. Mr. Casson's style makes for easy reading (as his *Steady Drummer* showed us) and his brilliant analysis (for example) of the progress of the human mind from the earliest days to the dawn of history, with its sudden advances and strange retrogressions, seems to be just an easy record of what happened—until we come to think about it and realise the learning that has gone into the making of it.

If this book has the circulation it deserves, and if it could be translated into all the languages of Europe, it might help to stem the next tide of barbarism before it is too late.

Latin America from the Air

Sailing South American Skies. By James Saxon Childers. (Barker. 7*s.* 6*d.*)

Sky Gipsy. By Claudia Cranston. (Harrap. 10*s.* 6*d.*)

Those who have visited South America will be aware of the crudities and discomforts which suddenly assail even the traveller de-luxe. In the reviewer's experience, nothing could be more nauseating than the three or four minutes which he spent in a market at Pernambuco. Nor will the atmosphere of a tram car in Lima be easily forgotten, even in a continent that takes garlic for granted. And it was disconcerting to be " warned " by a policeman on the Copocabana beach at Rio, for indulging in mixed bathing ! In this respect Mr. Childers' book is true to life and should be avoided by any reader who is inclined to be squeamish. Some of the revolting incidents he describes—for instance, a murder in Nicaragua—are not particularly relevant, except in being based on conversations during the journey.

But when the author gets down to his subject, the result is admirable. Vivid pictures of South American scenery, social life and economics are presented as the flight progresses from Texas to Mexico and Panama, down the west coast and across the Andes, then up the east coast to Brazil and the West Indies, and home again to Miami. Few people realise how vast is the network of air lines which now links up the United States with Central and South America. The pilots of Pan-American Airways cover a distance equivalent to a flight round the world every day. This service is among the wonders of the New World, and if the modern Columbus cares to travel by the Graf Zeppelin to Brazil—taking four days instead of sixteen—he can make a tour of the continent entirely by air.

Continuous contact by radio is maintained by every machine on all routes. The author describes a series of conversations which took place while flying over Ecuador. To begin with a friend in Guayaquil rang him up to see how he was feeling. Then a message was sent to an airways agent in Buenaventura, Colombia, asking for some historical information. This was picked up by an operator in Lima, who expressed his views on the problem, and also by another plane flying over Santiago. A few minutes later a further reply came from a pilot in Florida. " In between all this official reporting," Mr. Childers continues, " the radio man flying to Antofagasta, Chile, tells the man on his way to Lima, Peru, that there is a swell picture "—a good film—" at the theatre across the street from the Bolivar Hotel and that he shouldn't miss it ; and the man flying to La Paz in Bolivia cuts in to say that he saw it and it was lousy, and stay away from it. All that talk over the jungles and deserts and mountains of South America makes you feel as if you are back at the drug store at Opelika, Alabama." (Students of American slang will be glad to have discovered the home of

"lousy," that all-embracing adjective. Elsewhere in this book a school teacher from Nevada remarks that "Cuzco is just lousy with ruins.")

Apart from passenger transport, the airways of Latin America are being used to an increasing extent for commercial purposes. Rich estate owners in Brazil, Peru and Nicaragua get delicate strawberry plants from Florida by air. Rice samples for planting and experimental purposes are carried to the Guianas, while queen bees and entire hives now go by aeroplane. It appears that motor dealers in South America no longer maintain extensive stocks: they order what they need by air mail. One of the most spectacular jobs of air transport was done in Peru, at a gold mine 12,500 feet above the sea. The mine has been working since the days of the Incas, and a few years ago the operating company wanted to increase production, but could not do so without machinery. The trip for mules carrying ordinary loads from Cuzco required from ten days to three weeks; but some part of the necessary machinery could not be stripped down to parts small enough to be carried by mules over the narrow and difficult trails. Then someone thought of taking the equipment by air. The Pan-American Grace Company converted one of its passenger planes into a cargo plane, and in three months flew more machinery to the mine than the owners, with all their workmen, would have been able to assemble in a year.

Many sidelights on the habits of the people appear in these pages. Coffee planters in Guatemala do not employ watchmen to guard their crops; they plant stinging nettles along the boundaries of their estates. When a Peruvian hears the low murmuring rustle of the chaco ants, which march a million abreast into a house and eat every living thing in it—"flies, spiders and you too, if you happen to be there"—he leaves the premises while this novel form of spring cleaning is in progress. There are some interesting details on the shrinking of human heads by the Ecuadorian Indians.

On the whole, Mr. Childers avoids exaggeration, which cannot be said of the second book under review. Miss Cranston claims to be the first woman to have flown round Central and South America; her facts are usually accurate, but her language is often fantastic. It appears that some of the chapters were first published in an American magazine, as the author takes pains to impress on acquaintances that her public comprises "millions" of her fellow-countrymen. But her enthusiasm is fully justified, for anyone who travelled 25,000 miles in an aeroplane without being thrilled would be a dull dog.

It is a pity that Mr. Childers gives us no photographs. By contrast, the excellent pictures supplied by Pan-American Airways for Miss Cranston's book are its best feature.

Beaver Pioneers. By WENDELL and LUCIE CHAPMAN. (Scribners. 7*s* 6*d*.)

This charming volume, with its excellent photographs mostly by the authors, pursues, in America, the admirable method adopted by Miss Phyllis Kelway in England of telling the life story of an animal. Her many admirers will enjoy *Beaver Pioneers*. A pair of beavers (and family) are individualised and their adventures are related with a sympathetic but never a sentimental pen. An amusing interlude is provided by introducing the authors into the cast, but treating them anonymously and strictly from the beavers' point of view. Readers on this side of the Atlantic will probably be unpleasantly surprised by the news that the measures taken in America for protecting the beaver are by no means effective, and that what has really allowed them to remain as numerous as they are is merely the decreased demand for beaver fur. Apart altogether from its high entertainment value, this book will have served a useful purpose if it succeeds in directing official attention to the true state of affairs in the beaver world.

Short Reviews

Digestion and Health (WALTER B. CANNON; Secker & Warburg, 6*s*.) is a conducted tour of the digestive organs, with special reference to the effect upon them of the main nerves of the body. A long and valuable chapter is devoted to indigestion from excitement. The book is clearly written, and will be of benefit to all who are interested in the performance of the functions of the body.

Dictionary of Careers (L. H. TURNER; Pitman, 3*s*. 6*d*.) is a clearly printed alphabetic list of possible careers, giving one to two pages of information on requirements, prospects, examinations, etc., in each case. This very useful little book is now in its second edition.

The Museums of India (S. F. MARKHAM and H. HARGREAVES; The Museums Association, 5*s*.) is an illustrated survey of 105 museums in India, and a report upon their condition. The authors point out that some museums are so badly mismanaged that urgent reforms will be necessary to preserve many of the proofs of India's cultural greatness.

A Simple Study of Flight (J. D. HADDON; Pitman, 3*s*. 6*d*.), in the Aeronautical Engineering Series, contains a detailed description of the parts of the plane and how they operate, a nomenclature list and a bibliography.

Death from the Skies (Heinz Liepmann; Secker & Warburg, 6*s*.) is a study of gas and microbial warfare, written with some acrimony and hysteria, but nevertheless containing much useful information, sound counsel, and good pacifism. "Raise a Clamour, for God's sake"; this is the author's appeal, and it must not go unheeded.

The Conquest of the Stratosphere (C. G. Philp; Pitman, 7*s*. 6*d*.) is a close history of the various stratosphere flights which have been undertaken. A wealth of sound information and interesting anecdote is presented in a somewhat unpleasing type-face.

Revisiting my Pygmy Hosts (PAUL SCHEBESTA; Hutchinson, 18*s*.) will be welcome to those readers who enjoyed the author's two previous works concerning the same little people of the Congo. This volume is an account of a quite separate expedition among the "Bambuti," or Pygmy peoples, and is particularly interesting in those sections dealing with the social customs and folk-tales of the Pygmies. Only a traveller who had previously won the confidence of the shy Pygmies and could number individual friends among them would have been let so far into their domestic secrets as has Herr Schebesta. The photographs are as good as expected, which is saying a great deal.

Green Laurels (D. C. PEATTIE; Harrap, 12*s*. 6*d*.) provides a romantic and poetical volume dealing with the lives and achievements of great naturalists. Great lives are telescoped into small space and the purpose is certainly achieved of making the ignorant wish to know more of the work of the leading lights of natural science. Mr. Peattie writes from an American point of view and his chapters dealing with the flora and fauna of the New World are especially interesting. The publishers are to be congratulated on the get-up of the book, the production of which does full justice to the interest of the subject and to the affection which the author has evidently had for his work.

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